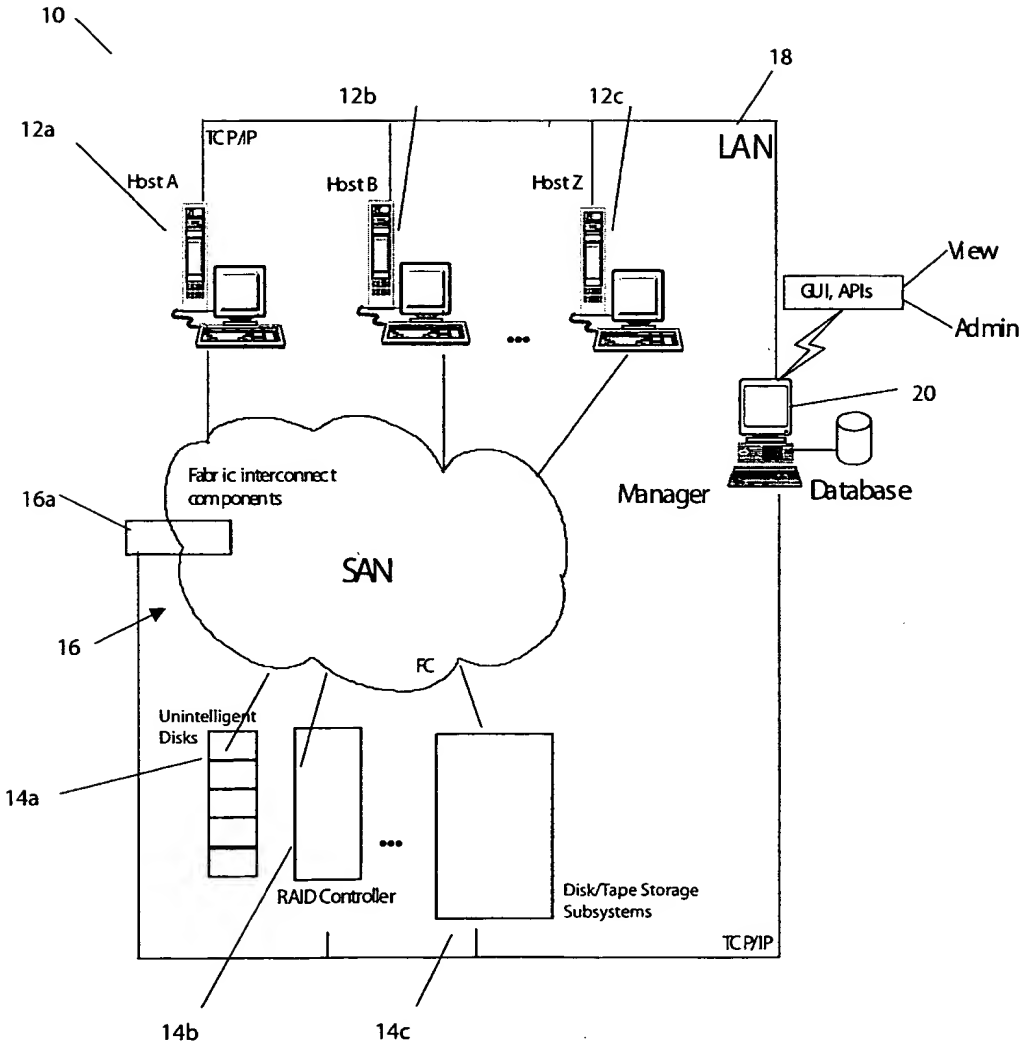

10
18
12b
12c
12a
TCP/IP
LAN
Host A
Host B
Host Z
View
GUI, APIs
Admin
20
Fabric interconnect components
Manager
Database
16a
SAN
16
FC
Unintelligent Disks
14a
RAID Controller
Disk/Tape Storage Subsystems
TCP/IP
14b
14c

Figure 1

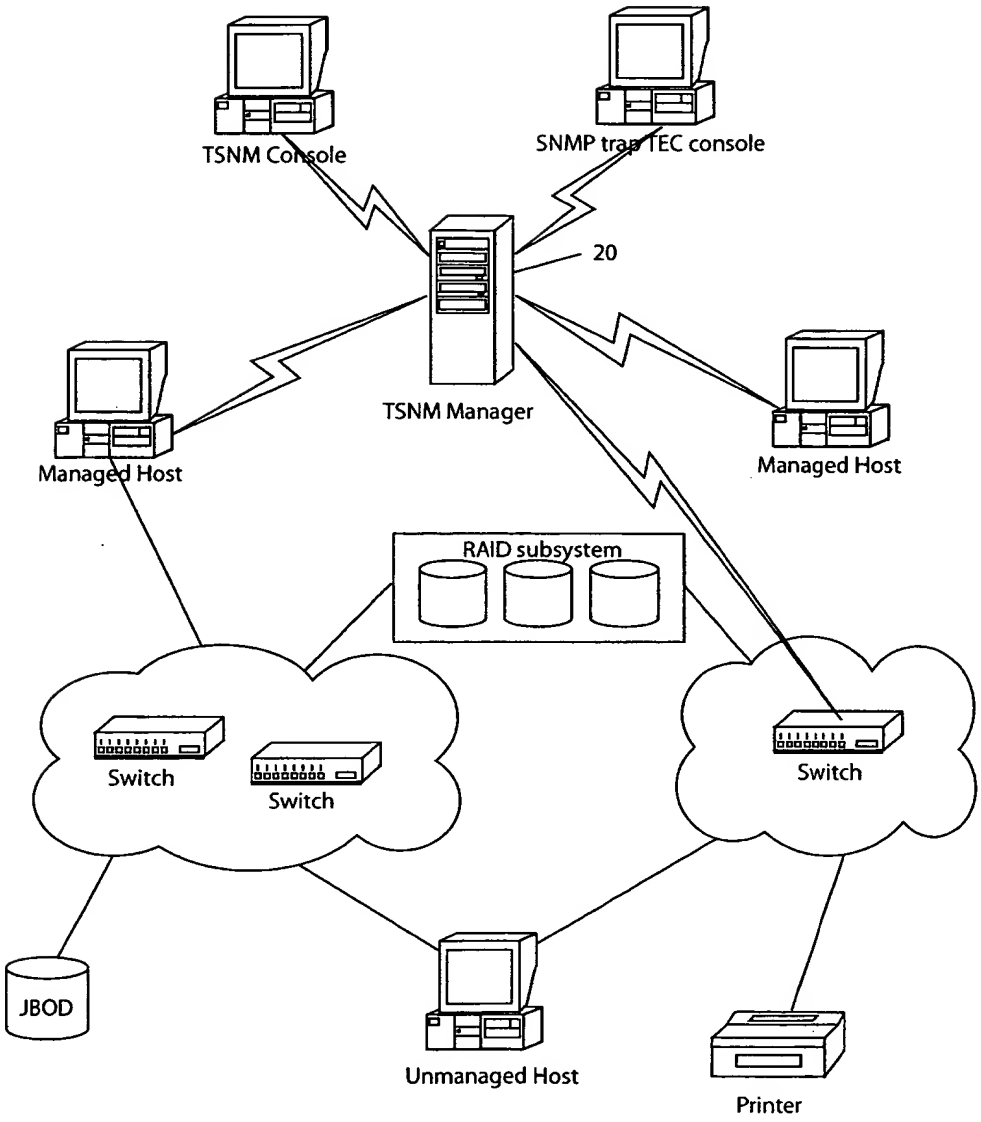

TSNM Console
SNMP trap TEC console
20
TSNM Manager
Managed Host
Managed Host
RAID subsystem
Switch
Switch
Switch
JBOD
Unmanaged Host
Printer

Figure 2

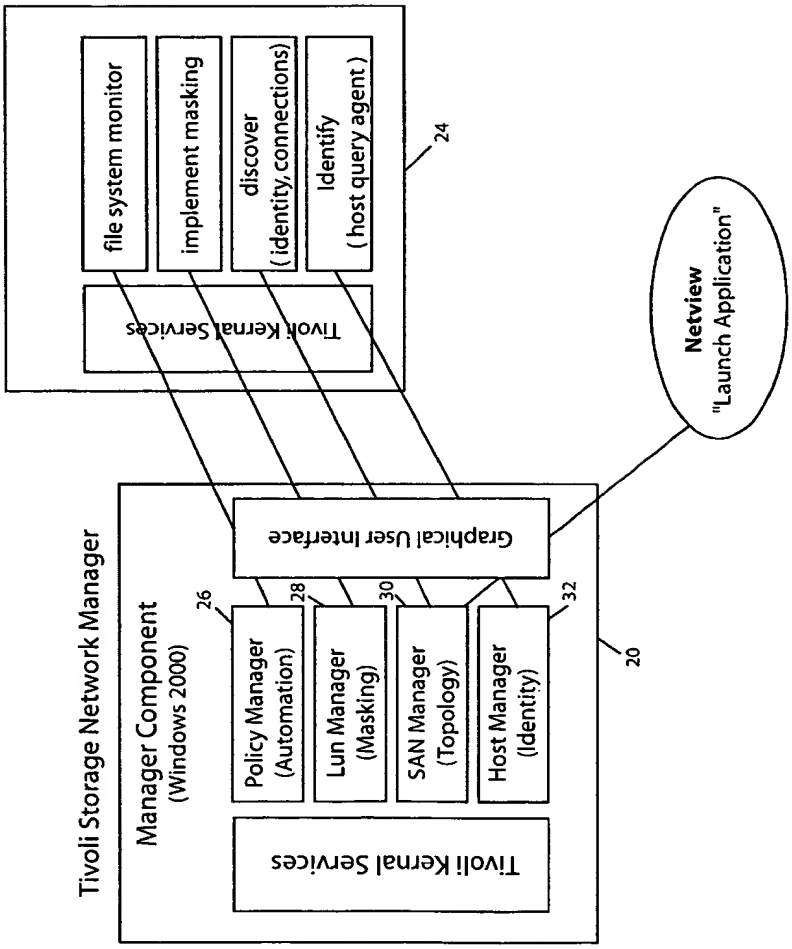

Tivoli Storage Network Manager
Manager Component
(Windows 2000)
Tivoli Kernal Services
Policy Manager
(Automation)
Lun Manager
(Masking)
SAN Manager
(Topology)
Host Manager
(Identity)
Graphical User Interface
26
28
30
32
20
Tivoli Kernal Services
file system monitor
implement masking
discover
(identity, connections)
Identify
(host query agent)
24
Netview
"Launch Application"

Figure 3

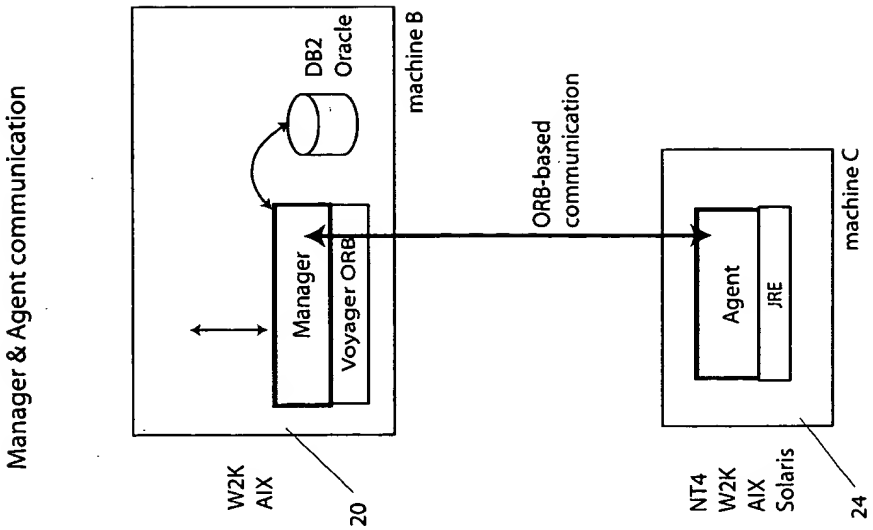

Manager & Agent communication
machine B
DB2
Oracle
Manager
Voyager ORB
ORB-based
communication
machine C
Agent
JRE
W2K
AIX
20
NT4
W2K
AIX
Solaris
24

Figure 4

"EL835825685US"

Figure 5

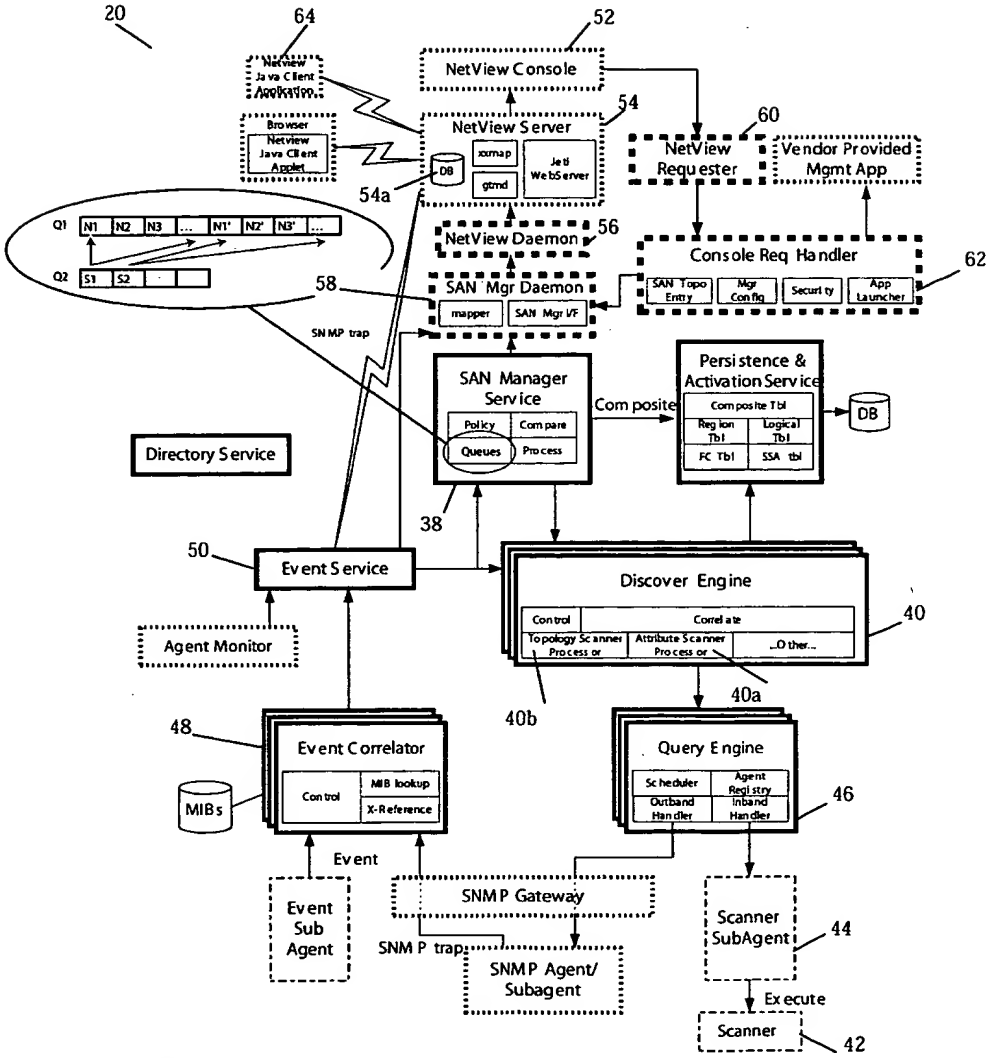

20
64
52
NetView Console
54
NetView Server
60
NetView Requester
Vendor Provided Mgmt App
Browser
Netview Java Client Applet
DB
xxmap
gtmd
Jeti WebServer
54a
Q1
N1
N2
N3
N1'
N2'
N3'
Q2
S1
S2
NetView Daemon
56
Console Req Handler
62
SAN Topo Entry
Mgr Config
Security
App Launcher
58
SAN Mgr Daemon
mapper
SAN Mgr I/F
SNMP trap
SAN Manager Service
Policy
Compare
Queues
Process
Composite
Persistence & Activation Service
Composite Tbl
Region Tbl
Logical Tbl
FC Tbl
SSA tbl
DB
Directory Service
38
50
Event Service
Discover Engine
Control
Correlate
Topology Scanner Processor
Attribute Scanner Processor
...Other...
40
Agent Monitor
40b
40a
48
Event Correlator
Control
MIB lookup
X-Reference
MIBs
Query Engine
Scheduler
Agent Registry
Outband Handler
Inband Handler
46
Event
Event Sub Agent
SNMP Gateway
SNMP trap
SNMP Agent/ Subagent
Scanner SubAgent
44
Execute
Scanner
42

Figure 6

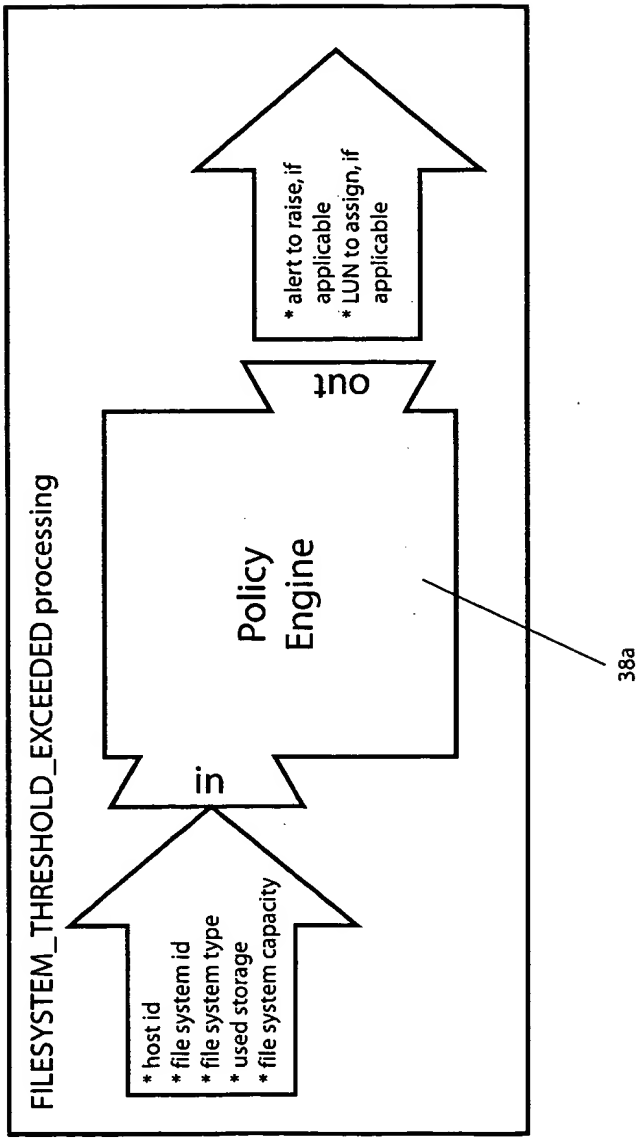

FILESYSTEM_THRESHOLD_EXCEEDED processing
* host id
* file system id
* file system type
* used storage
* file system capacity
in
Policy Engine
out
* alert to raise, if applicable
* LUN to assign, if applicable
38a

Figure 7A

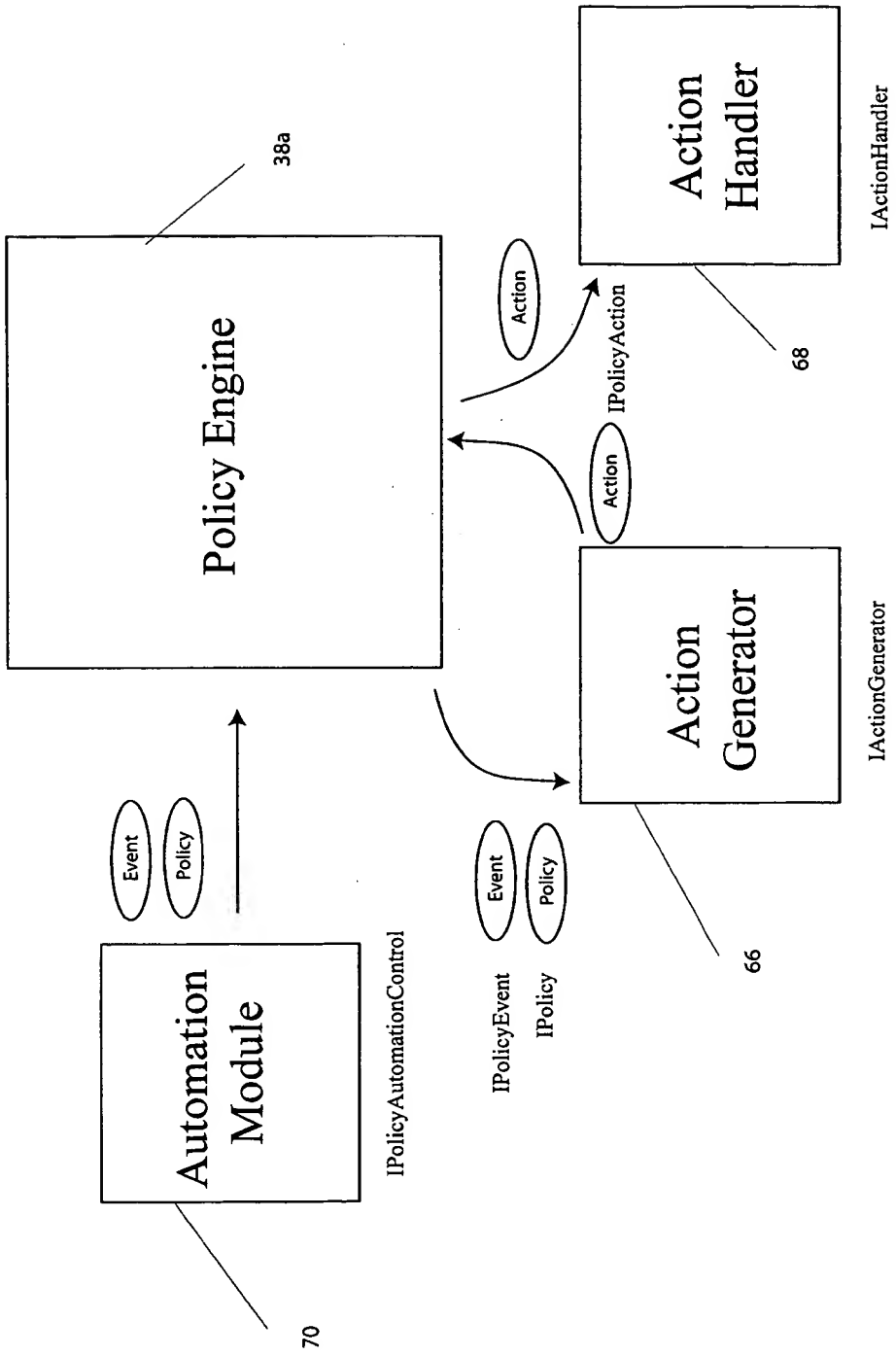

Automation Module
70
IPolicyAutomationControl
Event
Policy
Policy Engine
38a
IPolicyEvent
IPolicy
Action Generator
66
IActionGenerator
Action
IPolicyAction
Action Handler
68
IActionHandler

Figure 7B

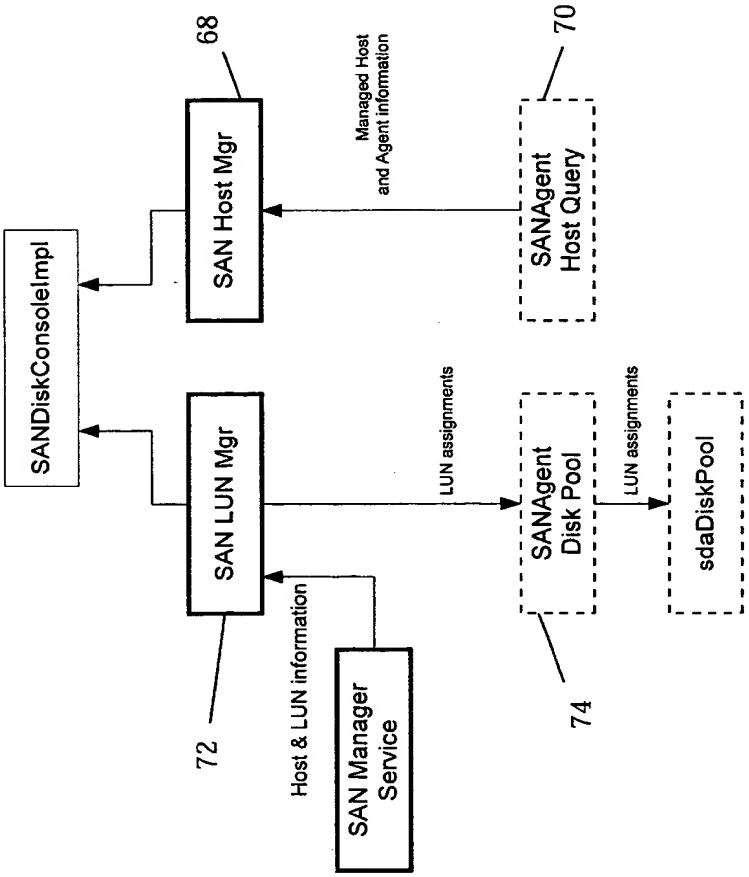

68
70
SAN Host Mgr
Managed Host and Agent information
SANAgent Host Query
SANDiskConsoleImpl
SAN LUN Mgr
LUN assignments
SANAgent Disk Pool
LUN assignments
sdaDiskPool
72
Host & LUN information
SAN Manager Service
74

Figure 8

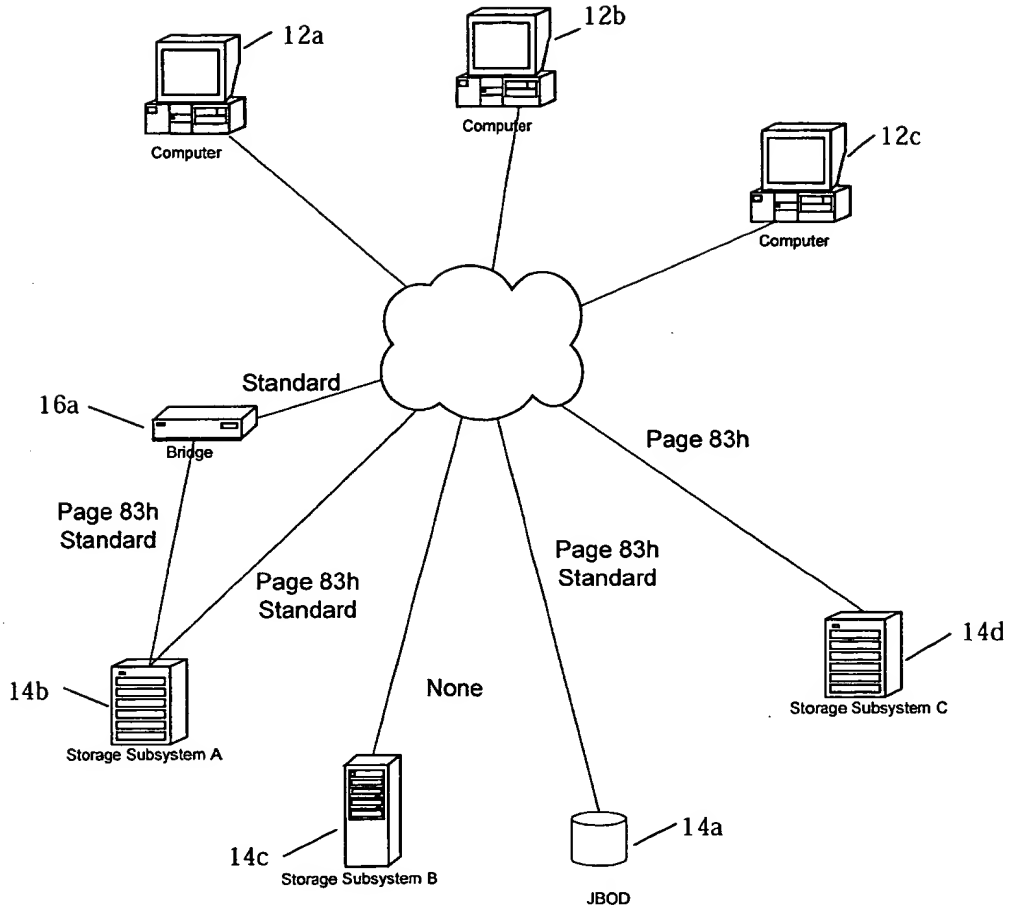
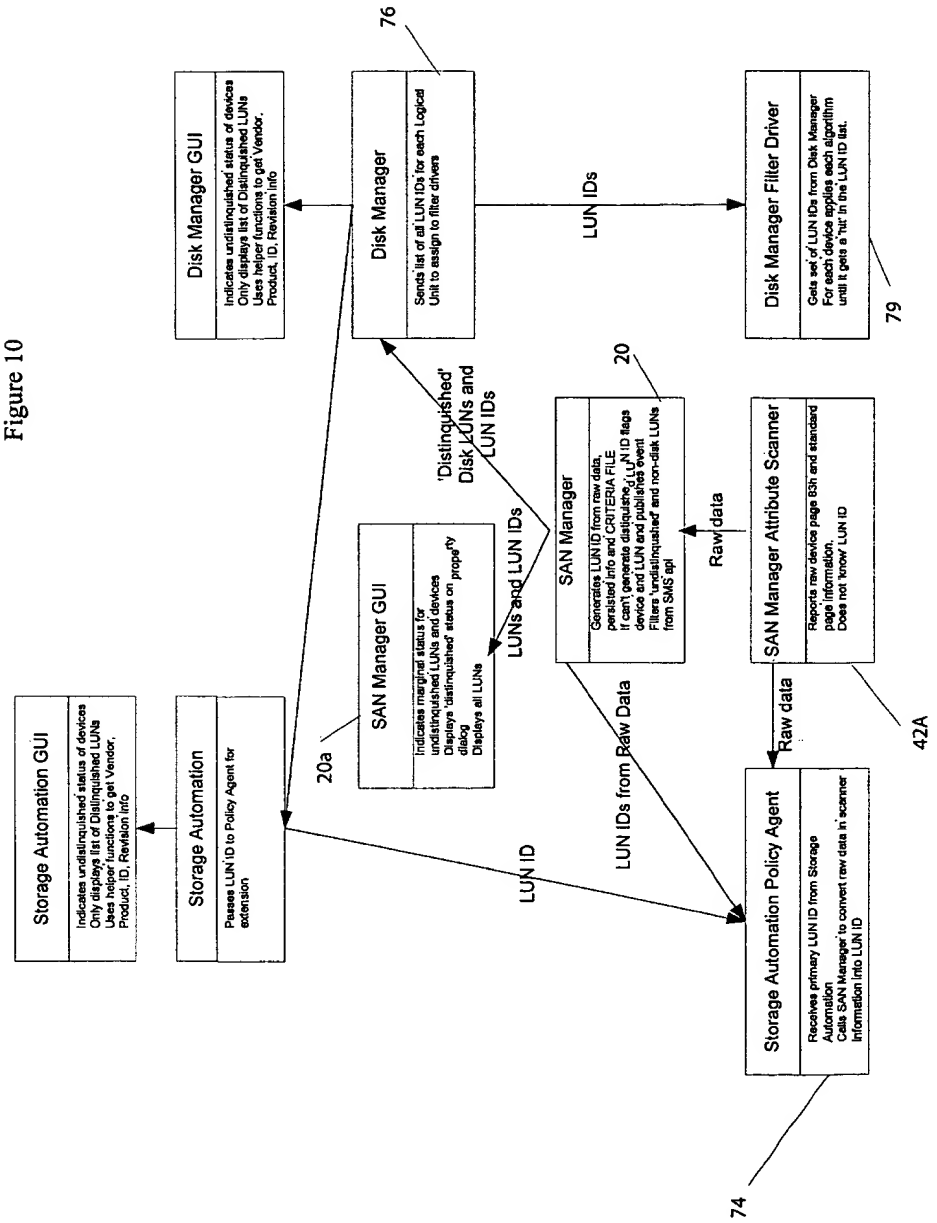

12a
Computer
12b
Computer
12c
Computer
Standard
16a
Bridge
Page 83h
Page 83h
Standard
Page 83h
Standard
Page 83h
Standard
14b
Storage Subsystem A
None
14c
Storage Subsystem B
14a
JBOD
14d
Storage Subsystem C

Figure 9

EL835825685US

Figure 10



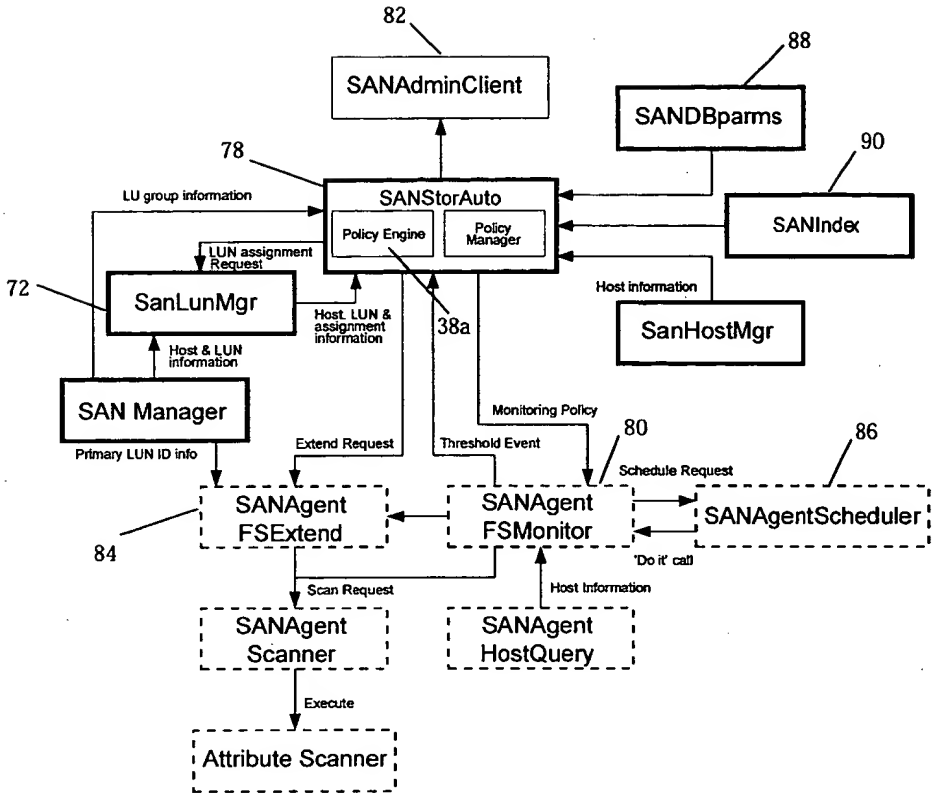

82
SANAdminClient
88
SANDBparms
78
90
LU group information
SANStorAuto
Policy Engine
Policy Manager
SANIndex
LUN assignment Request
72
SanLunMgr
Host LUN & assignment information
38a
Host information
SanHostMgr
Host & LUN information
SAN Manager
Monitoring Policy
80
86
Primary LUN ID info
Extend Request
Threshold Event
Schedule Request
SANAgent FSExtend
SANAgent FSMonitor
SANAgentScheduler
84
'Do it' call
Scan Request
Host Information
SANAgent Scanner
SANAgent HostQuery
Execute
Attribute Scanner

Figure 11

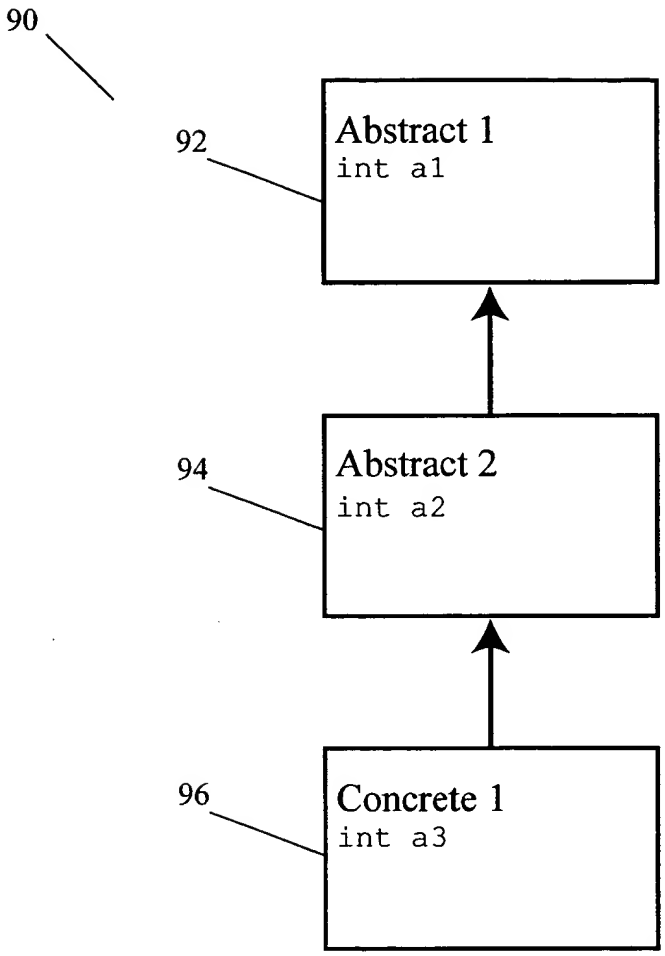

90
92
Abstract 1
int a1
94
Abstract 2
int a2
96
Concrete 1
int a3

Figure 12

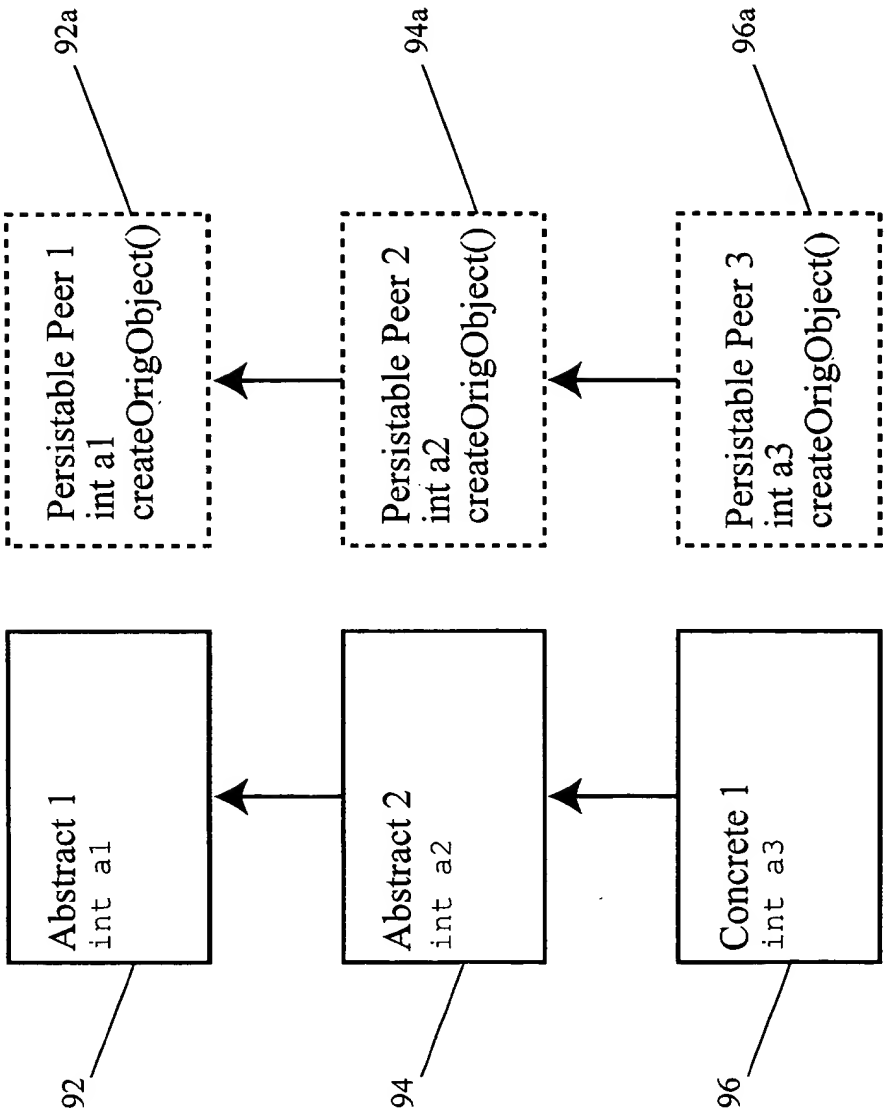

92a
94a
96a
Persistable Peer 1
int a1
createOrigObject()
Persistable Peer 2
int a2
createOrigObject()
Persistable Peer 3
int a3
createOrigObject()
Abstract 1
int a1
Abstract 2
int a2
Concrete 1
int a3
92
94
96

Figure 13

Figure 14a

Figure 14b

Figure 14c

Figure 14d

EL835825685US

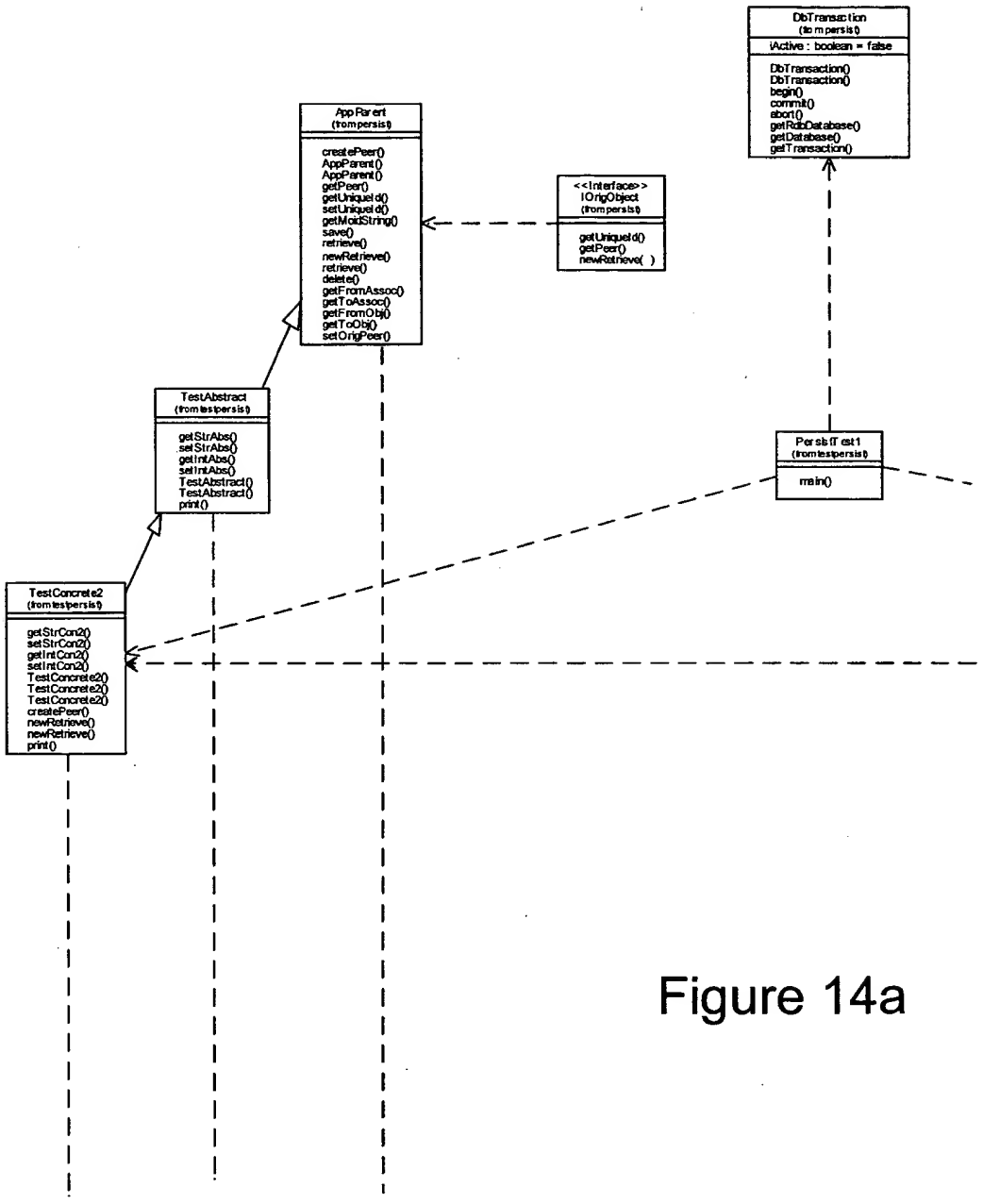

DbTransaction
(fompersist)
iActive : boolean = false
DbTransaction()
DbTransaction()
begin()
commit()
abort()
getRdbDatabase()
getDatabase()
getTransaction()
AppParent
(frompersist)
createPeer()
AppParent()
AppParent()
getPeer()
getUniqueId()
setUniqueId()
getMoidString()
save()
retrieve()
newRetrieve()
retrieve()
delete()
getFromAssoc()
getToAssoc()
getFromObj()
getToObj()
setOrigPeer()
<<Interface>>
IOrigObject
(frompersist)
getUniqueId()
getPeer()
newRetrieve( )
TestAbstract
(fromtestpersist)
getStrAbs()
setStrAbs()
getIntAbs()
setIntAbs()
TestAbstract()
TestAbstract()
print()
PersistTest1
(fromtestpersist)
main()
TestConcrete2
(fromtestpersist)
getStrCon2()
setStrCon2()
getIntCon2()
setIntCon2()
TestConcrete2()
TestConcrete2()
TestConcrete2()
createPeer()
newRetrieve()
newRetrieve()
print()

Figure 14a

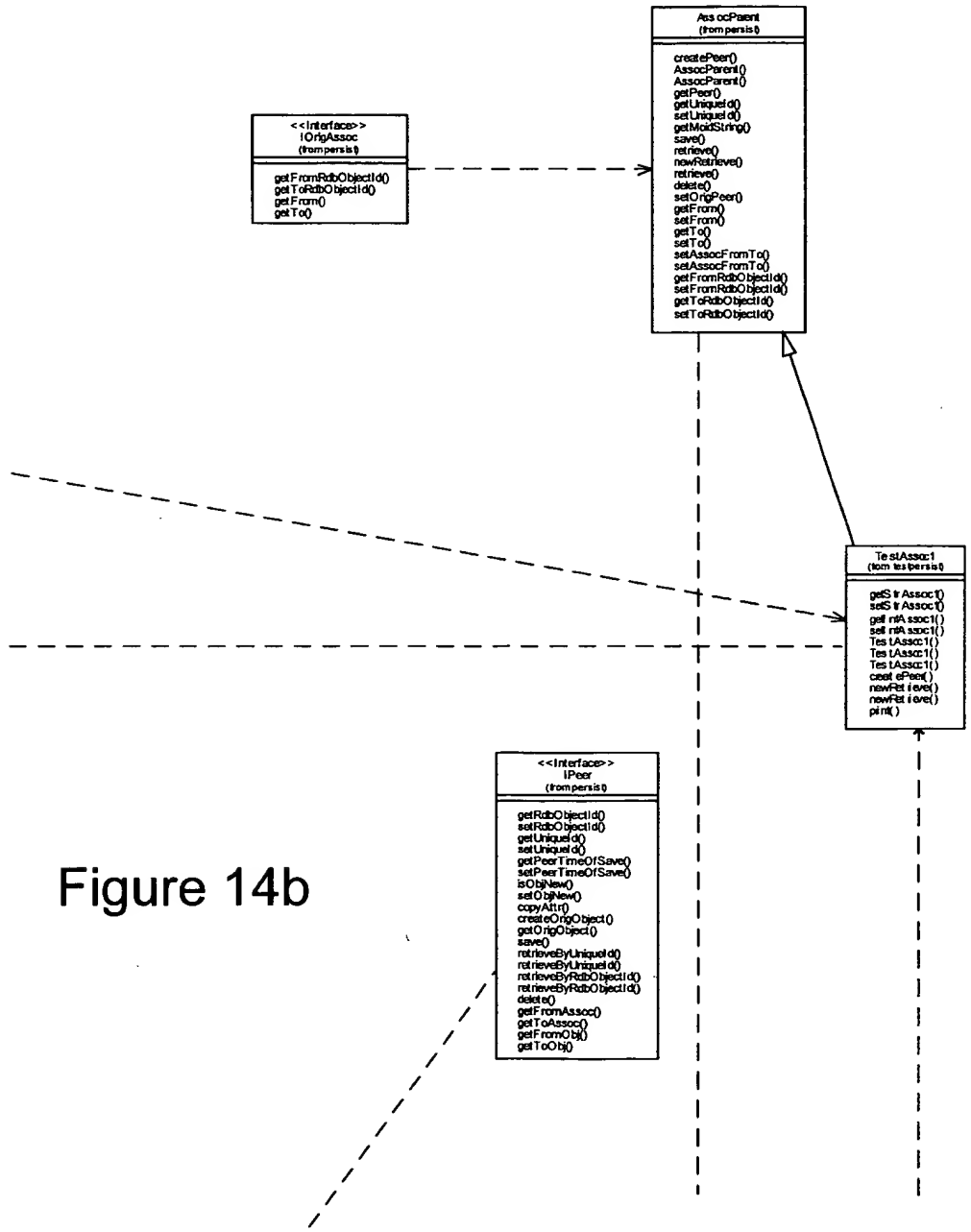


Figure 14b

P09501-1950760

EL835825685US

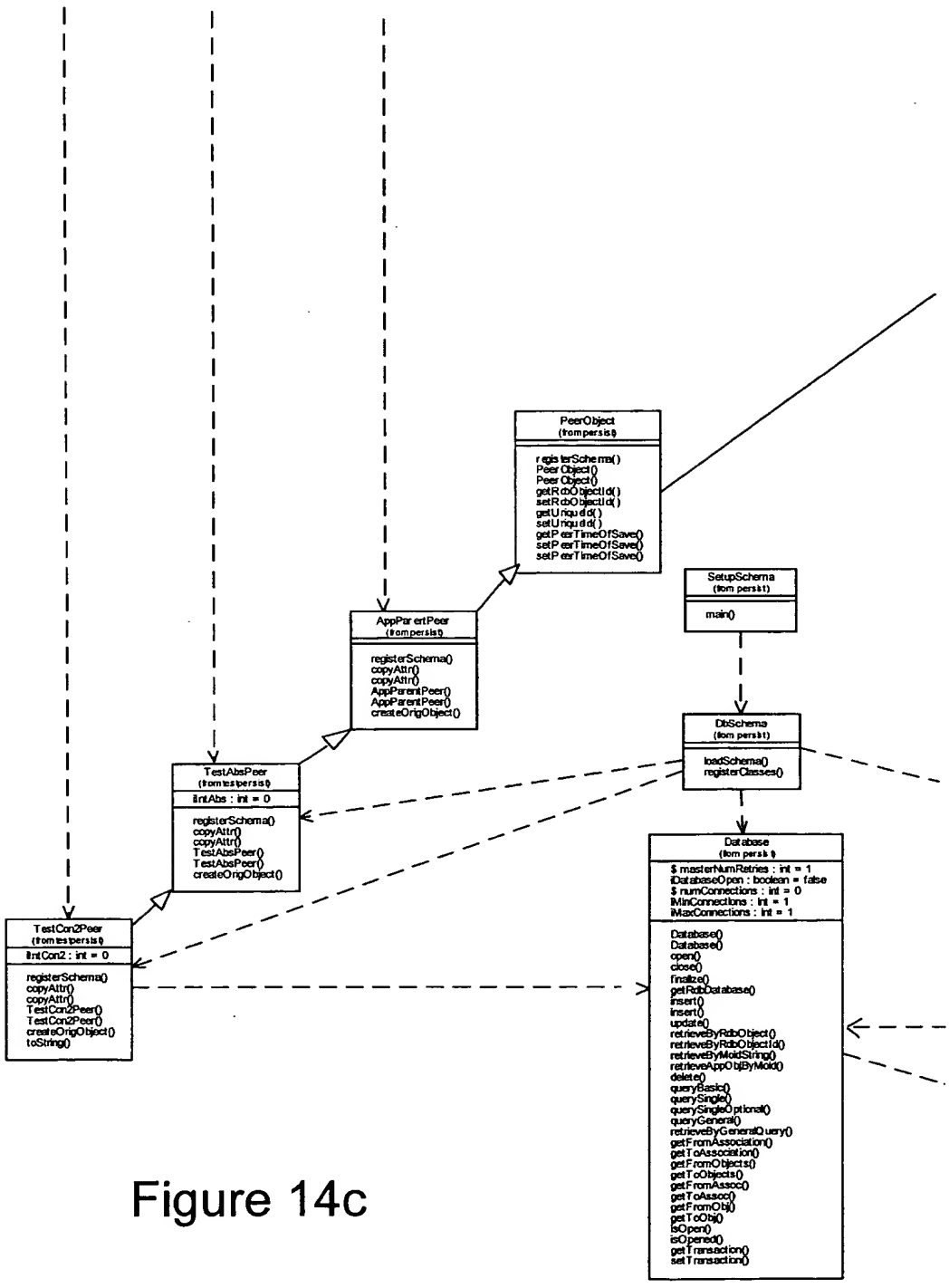


Figure 14c

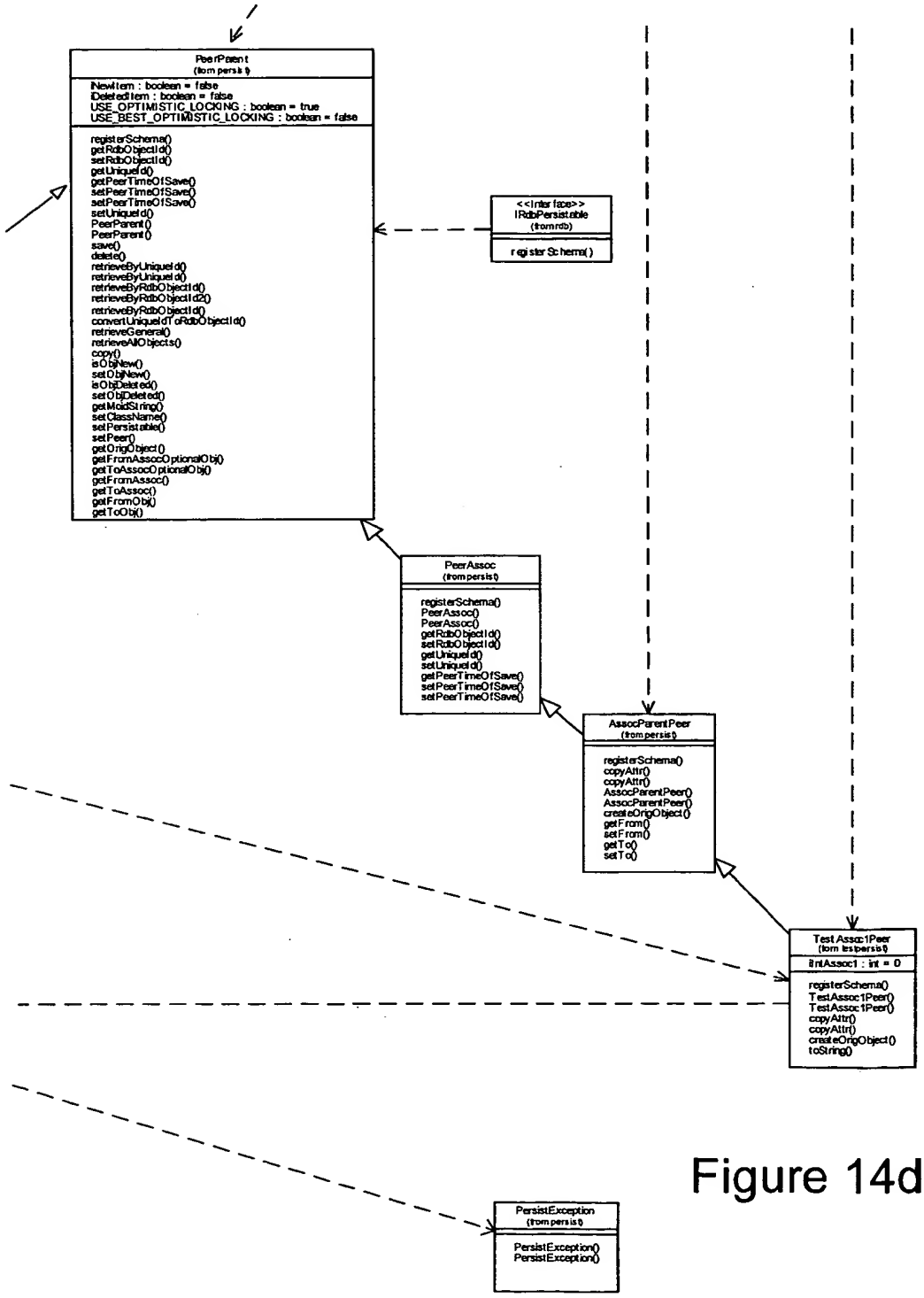

PeerParent
(from persist)
iNewItem : boolean = false
iDeletedItem : boolean = false
USE_OPTIMISTIC_LOCKING : boolean = true
USE_BEST_OPTIMISTIC_LOCKING : boolean = false
registerSchema()
getRdbObjectId()
setRdbObjectId()
getUniqueId()
getPeerTimeOfSave()
setPeerTimeOfSave()
setPeerTimeOfSave()
setUniqueId()
PeerParent()
PeerParent()
save()
delete()
retrieveByUniqueId()
retrieveByUniqueId()
retrieveByRdbObjectId()
retrieveByRdbObjectId2()
retrieveByRdbObjectId()
convertUniqueIdToRdbObjectId()
retrieveGeneral()
retrieveAllObjects()
copy()
isObjNew()
setObjNew()
isObjDeleted()
setObjDeleted()
getMoldString()
setClassName()
setPersistable()
setPeer()
getOrigObject()
getFromAssocOptionalObj()
getToAssocOptionalObj()
getFromAssoc()
getToAssoc()
getFromObj()
getToObj()
<<Interface>>
IRdbPersistable
(from rdb)
registerSchema()
PeerAssoc
(from persist)
registerSchema()
PeerAssoc()
PeerAssoc()
getRdbObjectId()
setRdbObjectId()
getUniqueId()
setUniqueId()
getPeerTimeOfSave()
setPeerTimeOfSave()
setPeerTimeOfSave()
AssocParentPeer
(from persist)
registerSchema()
copyAttr()
copyAttr()
AssocParentPeer()
AssocParentPeer()
createOrigObject()
getFrom()
setFrom()
getTo()
setTo()
Test Assoc1Peer
(from testpersist)
iIntAssoc1 : int = 0
registerSchema()
TestAssoc1Peer()
TestAssoc1Peer()
copyAttr()
copyAttr()
createOrigObject()
toString()
PersistException
(from persist)
PersistException()
PersistException()

Figure 14d

GUI (server) & Manager communication
▲ Manager creates objects (services) and "bind" them to Voyager directory service
▲ GUI "looks up" the object by name in directory service and get the object "proxy"
▲ GUI invokes object methods to obtain info or perform operation
Example: Class TDMServer( )
LUN[ ] getAccessibleLunsByHost(HostaHost)
LUN[ ] getAccessibleLunsByHost (java.lang.String ip)
LUN[ ] getAllAccessibleLuns( )
LUN[ ] getAssignedLunsByHost(HostaHost)
LUN[ ] getAssignedLunsByHost(java.lang.String ip)
// Look up the ITdm Server proxy object from the directory service
ITdmServeraTdm = (ITdm Server) Namespace.lookup(
"//localhost:9000/sandir/TdmServer");
// Get a list of all LUN objects in the region.
LUN[ ] temp1 = aTdm.getAllAccessibleLuns( );
GUI server
Presentation
TCP/IP - ORB
Manager
Voyager
DB2
Oracle
machine B
W2K, AIX
98
20

Figure 15

T0S0T "T6E2650

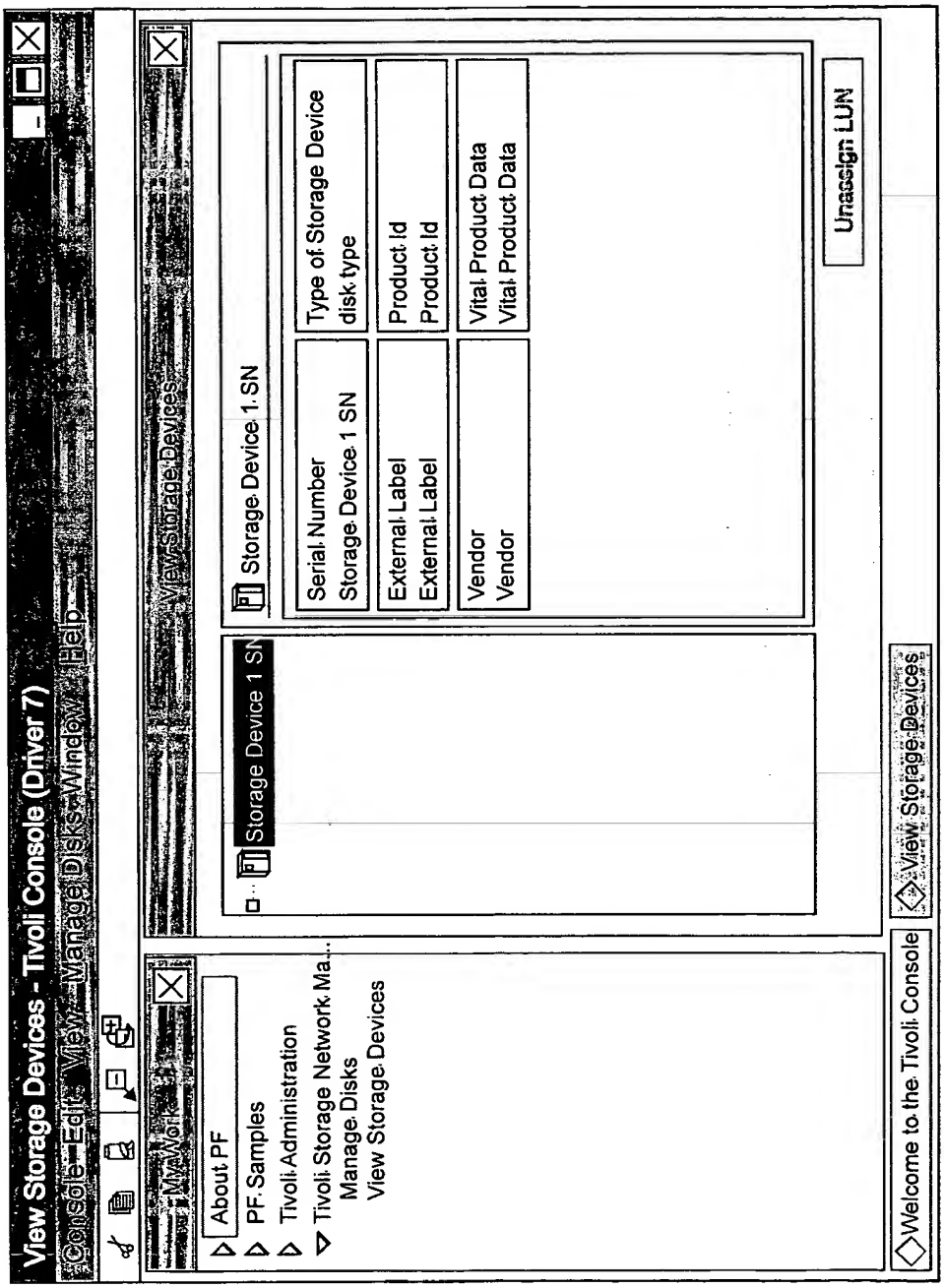


Figure 16

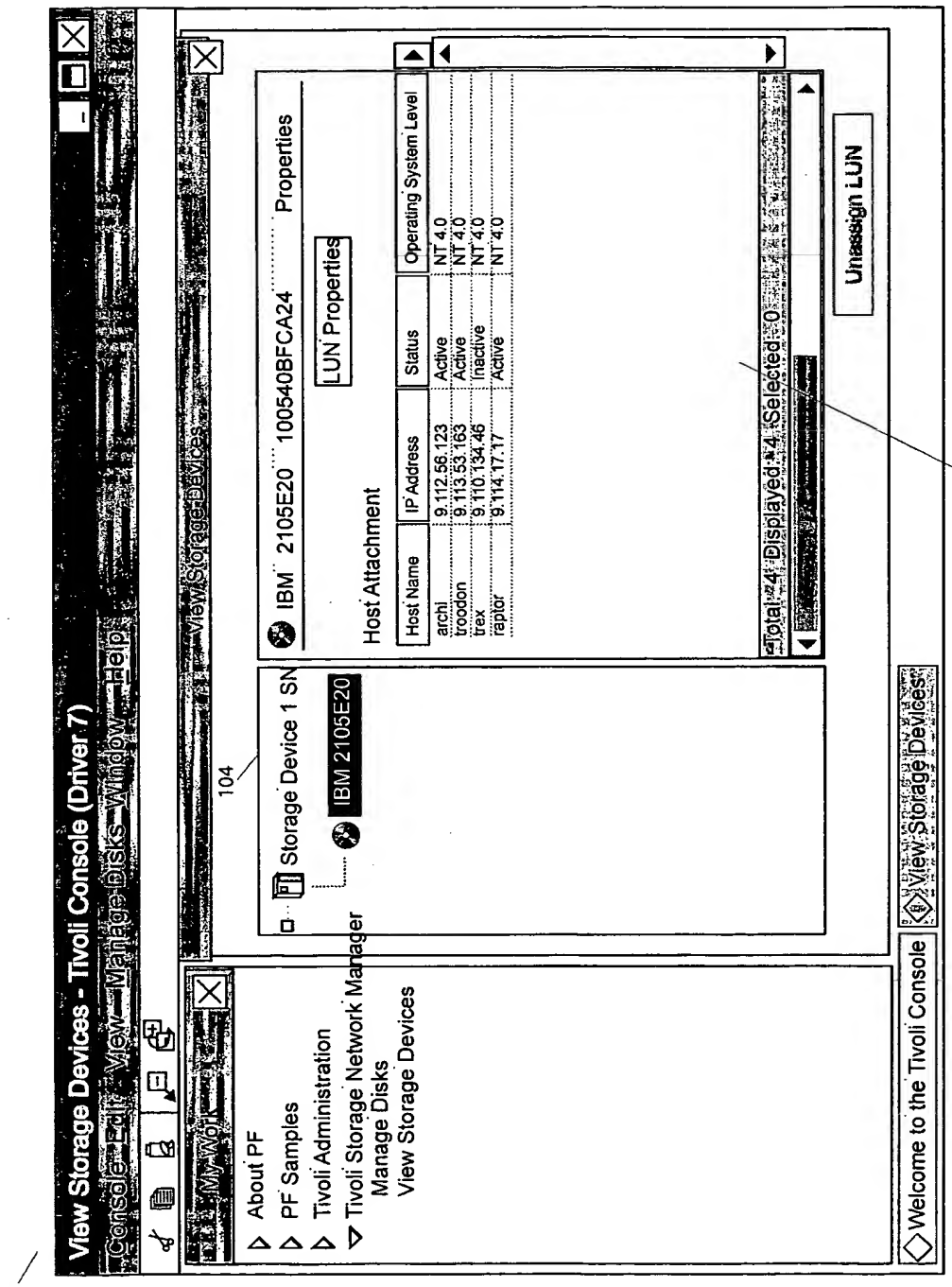

View Storage Devices - Tivoli Console (Driver 7)
Console Edit View Manage Disks Window Help
My Work
About PF
PF Samples
Tivoli Administration
Tivoli Storage Network Manager
Manage Disks
View Storage Devices
View Storage Devices
Storage Device 1 SN
IBM 2105E20
IBM 2105E20 100540BFCA24 Properties
LUN Properties
Host Attachment
Host Name
IP Address
Status
Operating System Level
archi 9.112.56.123 Active NT 4.0
troodon 9.113.53.163 Active NT 4.0
trex 9.110.134.46 Inactive NT 4.0
raptor 9.114.17.17 Active NT 4.0
Total: 4 Displayed: 4 Selected: 0
Unassign LUN
Welcome to the Tivoli Console
View Storage Devices
102
104
106

Figure 17

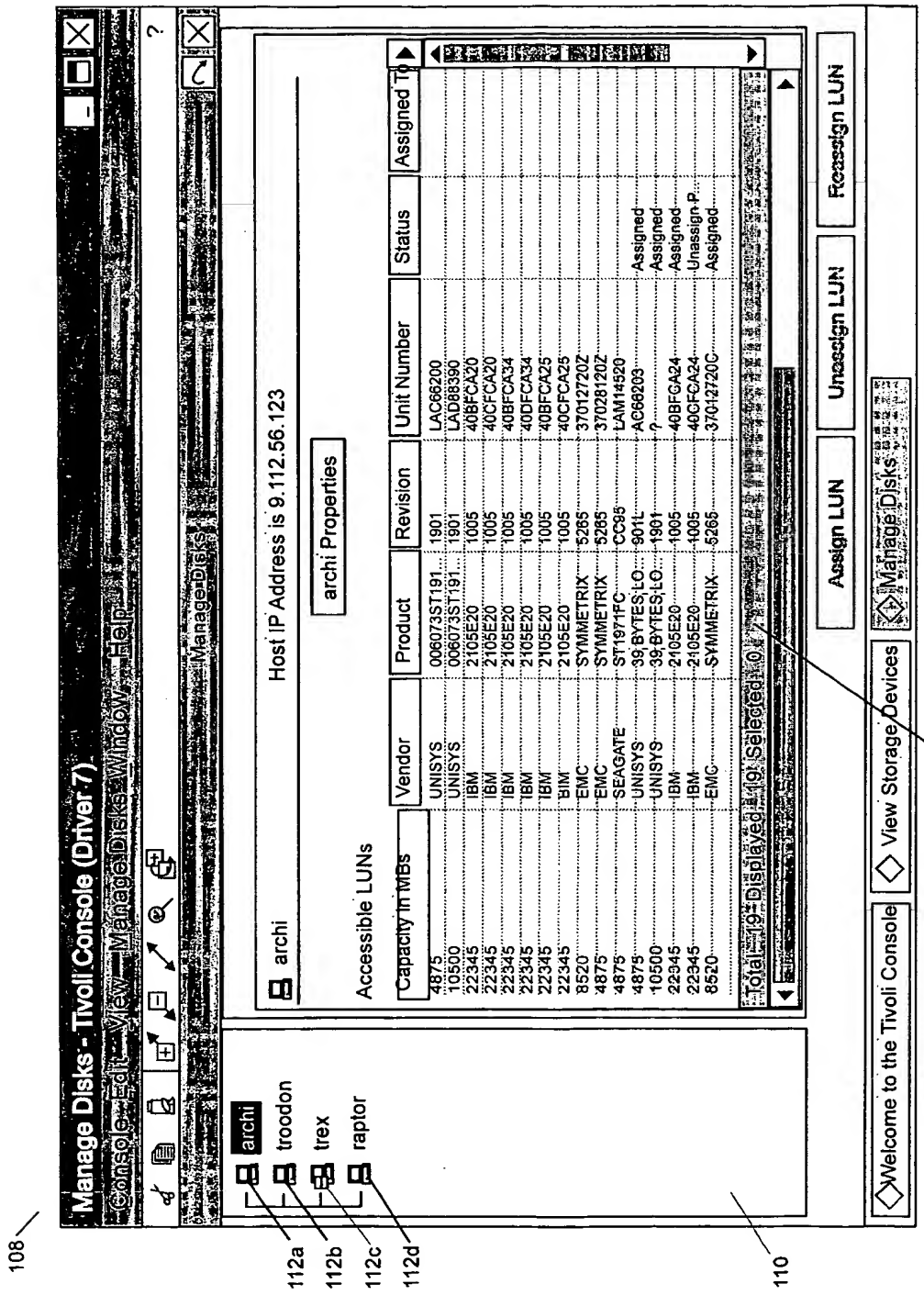

Manage Disks - Tivoli Console (Driver 7)
Console Edit View Manage Disks Window Help
Manage Disks
archi
troodon
trex
raptor
Host IP Address is 9.112.56.123
archi Properties
Accessible LUNs
Capacity in MBs
Vendor
Product
Revision
Unit Number
Status
Assigned To
Total 19 Displayed 19 Selected 0
Assign LUN
Unassign LUN
Reassign LUN
Welcome to the Tivoli Console
View Storage Devices
Manage Disks
108
112a
112b
112c
112d
110
114

Figure 18

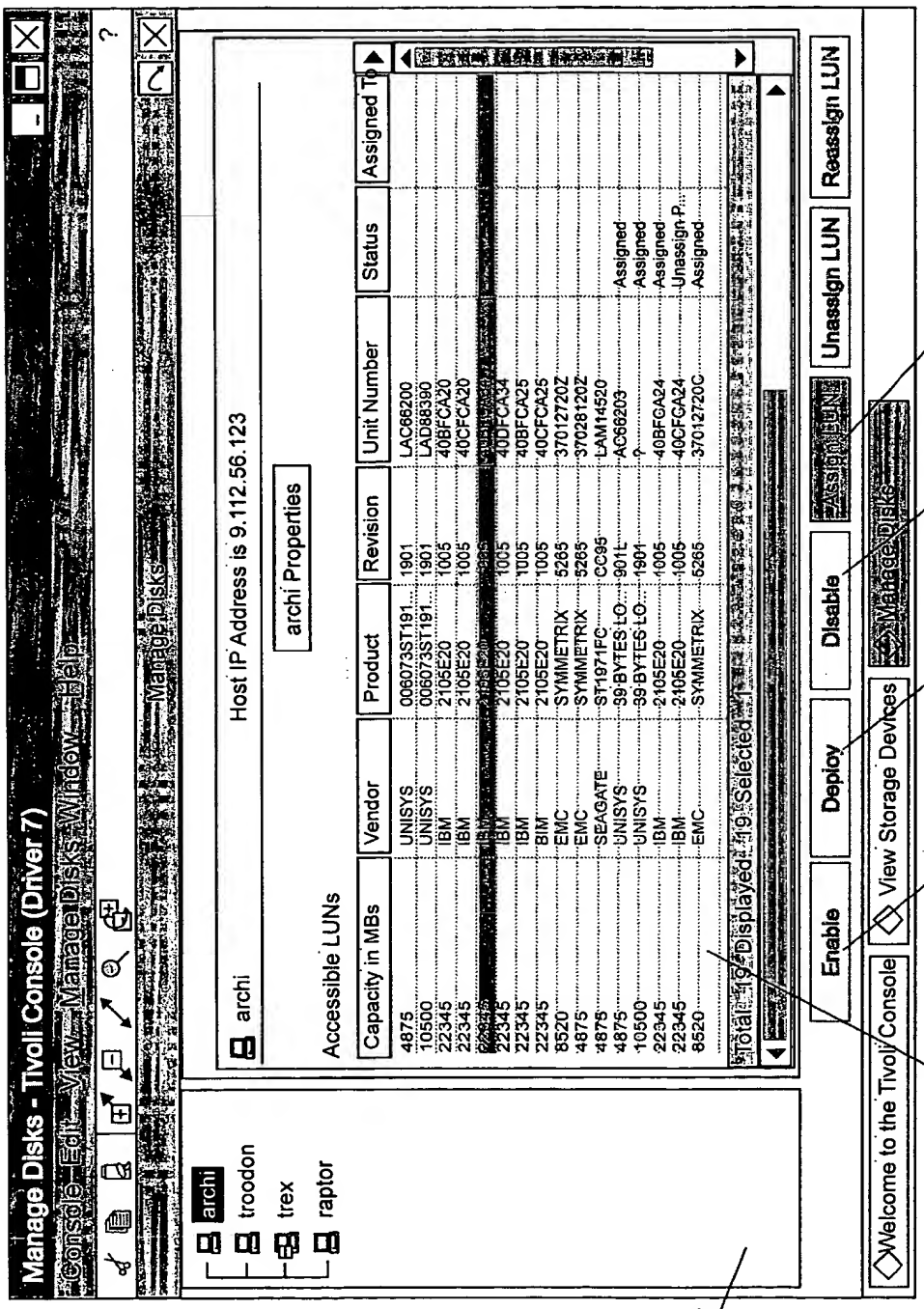

Manage Disks - Tivoli Console (Driver 7)
Console Edit View Manage Disks Window Help
Manage Disks
archi
troodon
trex
raptor
archi
Host IP Address is 9.112.56.123
archi Properties
Accessible LUNs
Capacity in MBs
Vendor
Product
Revision
Unit Number
Status
Assigned To
4875 UNISYS 006073ST191... 1901 LAC86200
10500 UNISYS 006073ST191 1901 LAD88390
22345 IBM 2105E20 1005 40BFCA20
22345 IBM 2105E20 1005 40CFCA20
22345 IBM 2105E20 1005 40DFCA34
22345 IBM 2105E20 1005 40BFCA25
22345 IBM 2105E20 1005 40CFCA25
8520 EMC SYMMETRIX 5265 370127202
4875 EMC SYMMETRIX 5265 370281202
4875 SEAGATE ST1971FC CC95 LAM14520
4875 UNISYS 39 BYTES LO... 901L AC66203 Assigned
10500 UNISYS 39 BYTES LO... 1901 ? Assigned
22345 IBM 2105E20 1005 40BFCA24 Assigned
22345 IBM 2105E20 1005 40CFCA24 Unassign P...
8520 EMC SYMMETRIX 5265 37012720C Assigned
Total: 19 Displayed: 19 Selected: 1
Enable
Deploy
Disable
Assign LUN
Unassign LUN
Reassign LUN
Welcome to the Tivoli Console
View Storage Devices
Manage Disks
110
114
116a
116b
116c
116

Figure 19

TOSOT "TE2650

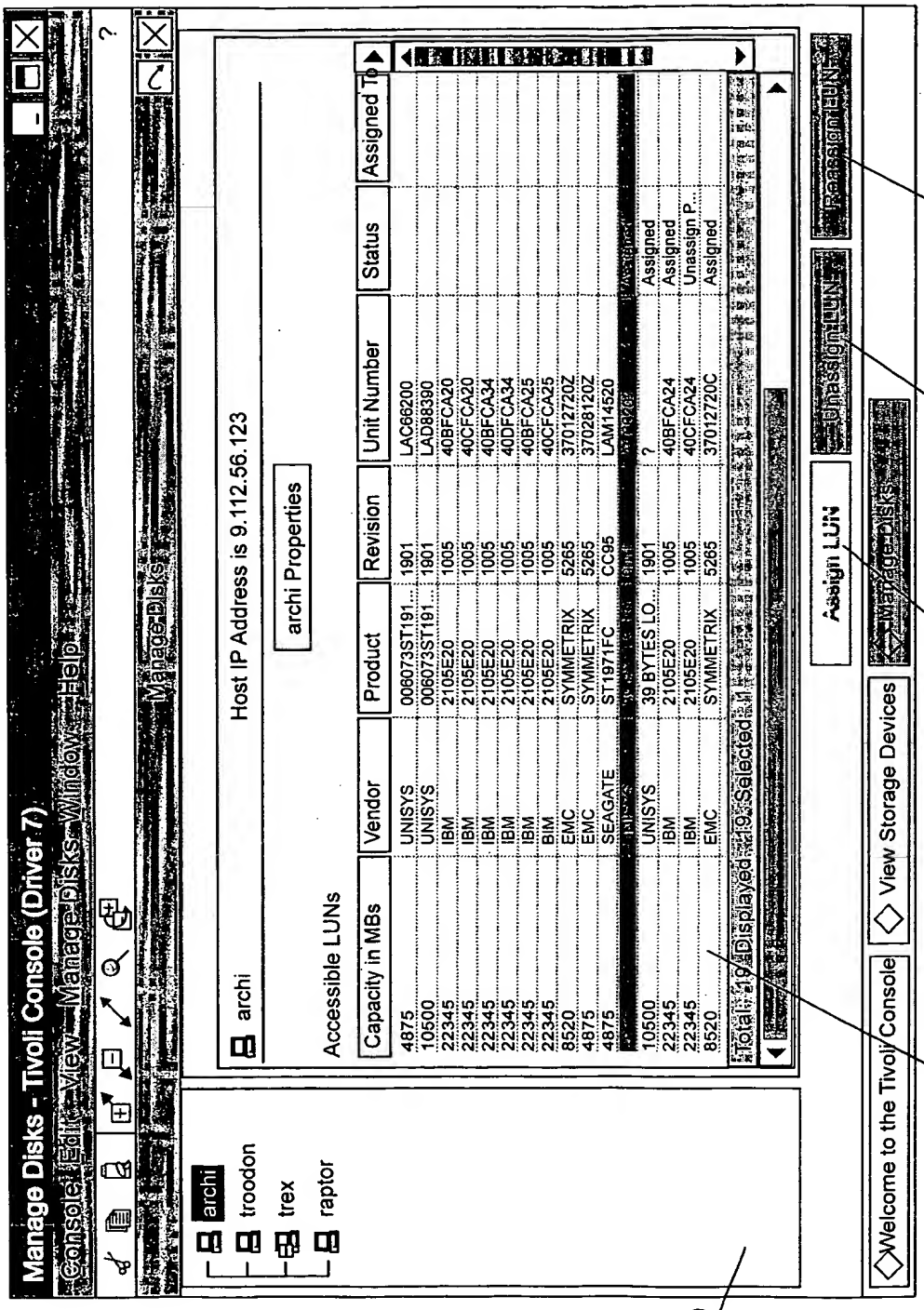


Figure 20

Clearing the Filter

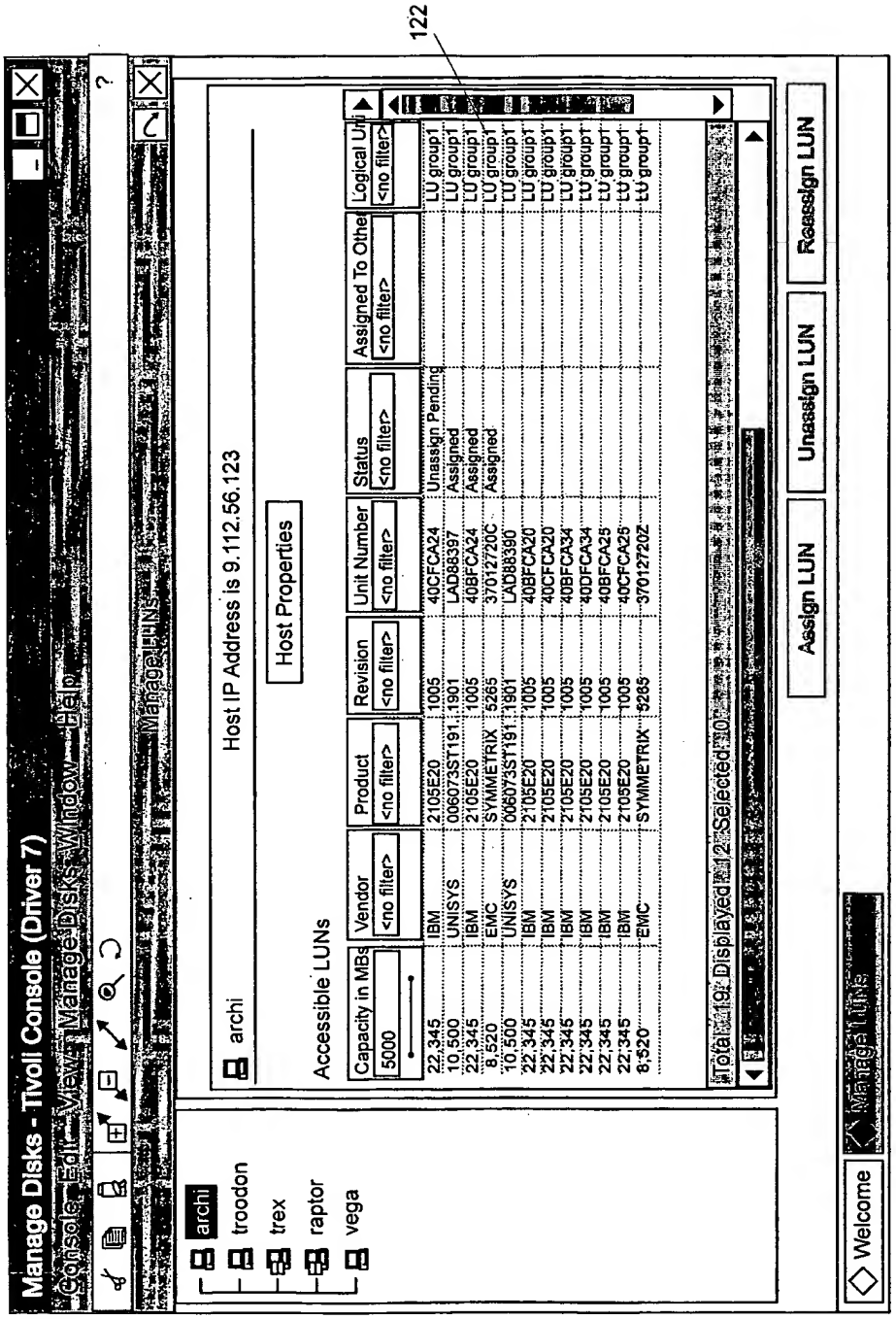


Figure 21

T0S0T" T6Z6S0

Custom Filtering

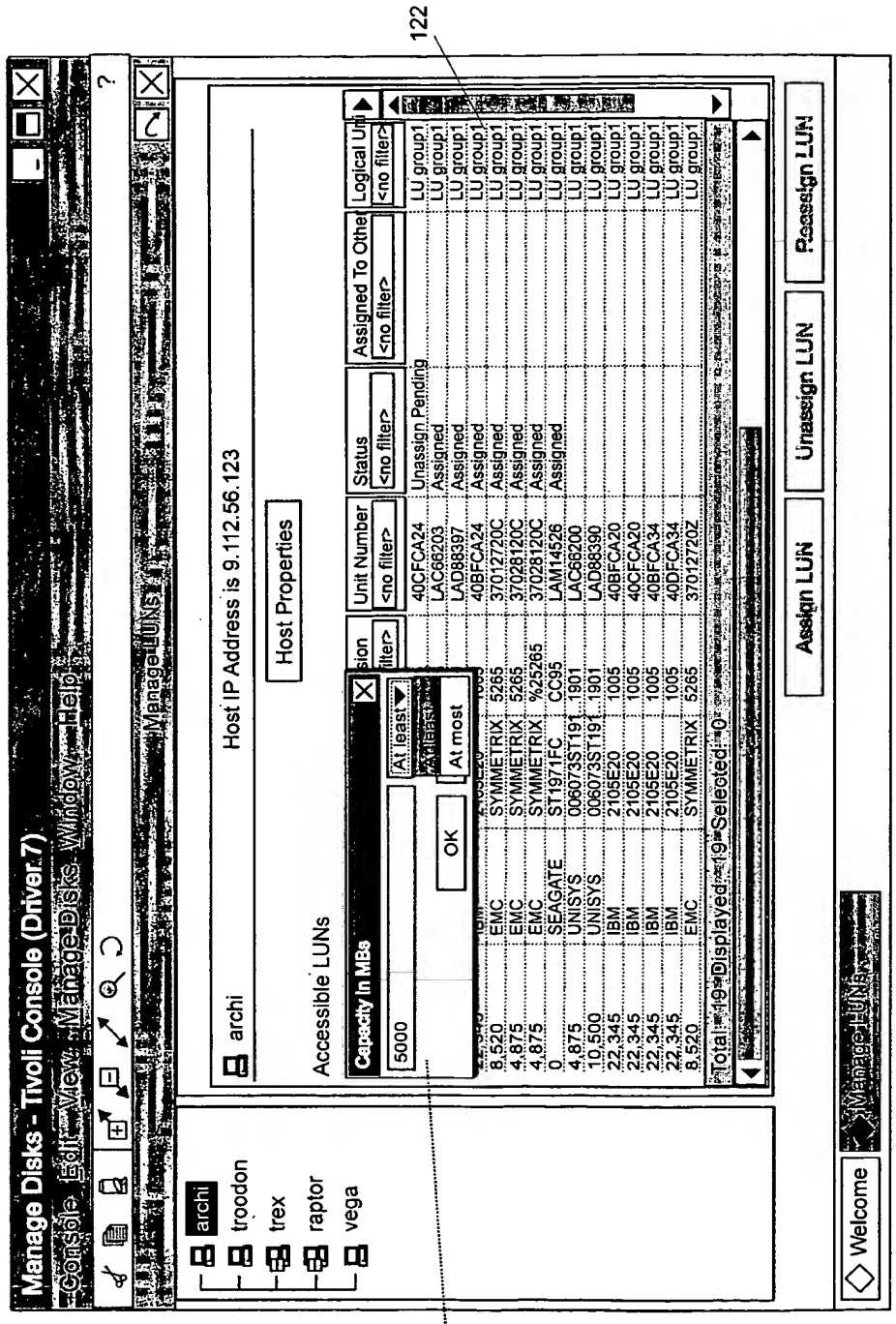


Figure 22

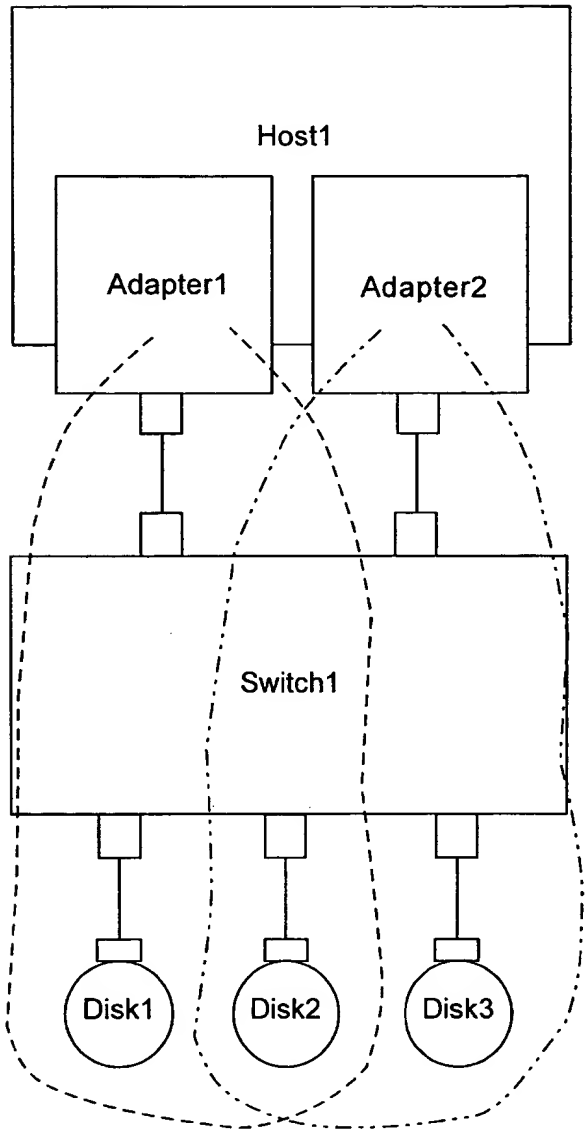


Figure 23

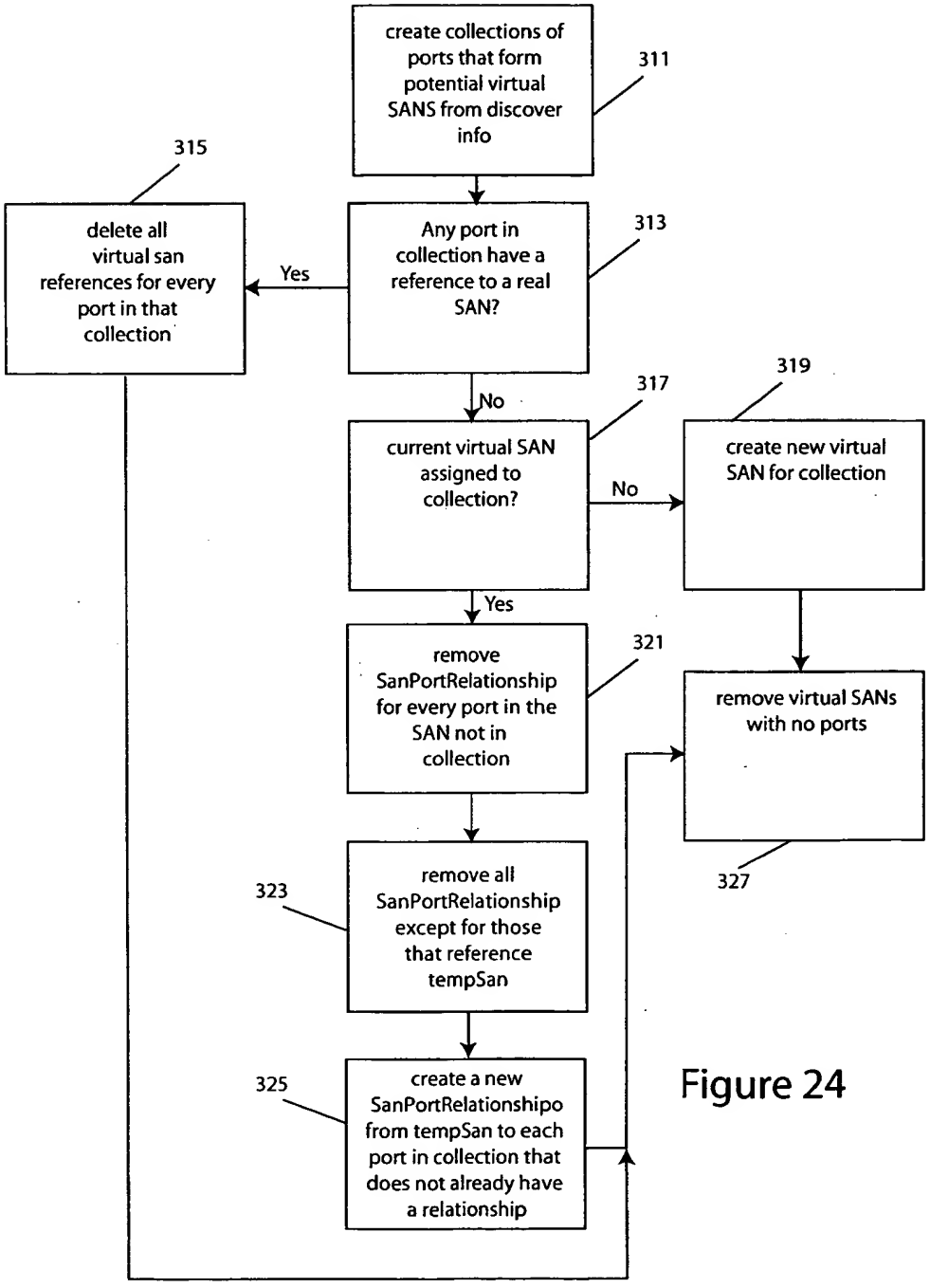

create collections of ports that form potential virtual SANS from discover info
311
Any port in collection have a reference to a real SAN?
313
Yes
315
delete all virtual san references for every port in that collection
No
current virtual SAN assigned to collection?
317
No
319
create new virtual SAN for collection
Yes
remove SanPortRelationship for every port in the SAN not in collection
321
remove virtual SANs with no ports
327
remove all SanPortRelationship except for those that reference tempSan
323
create a new SanPortRelationshipo from tempSan to each port in collection that does not already have a relationship
325

Figure 24

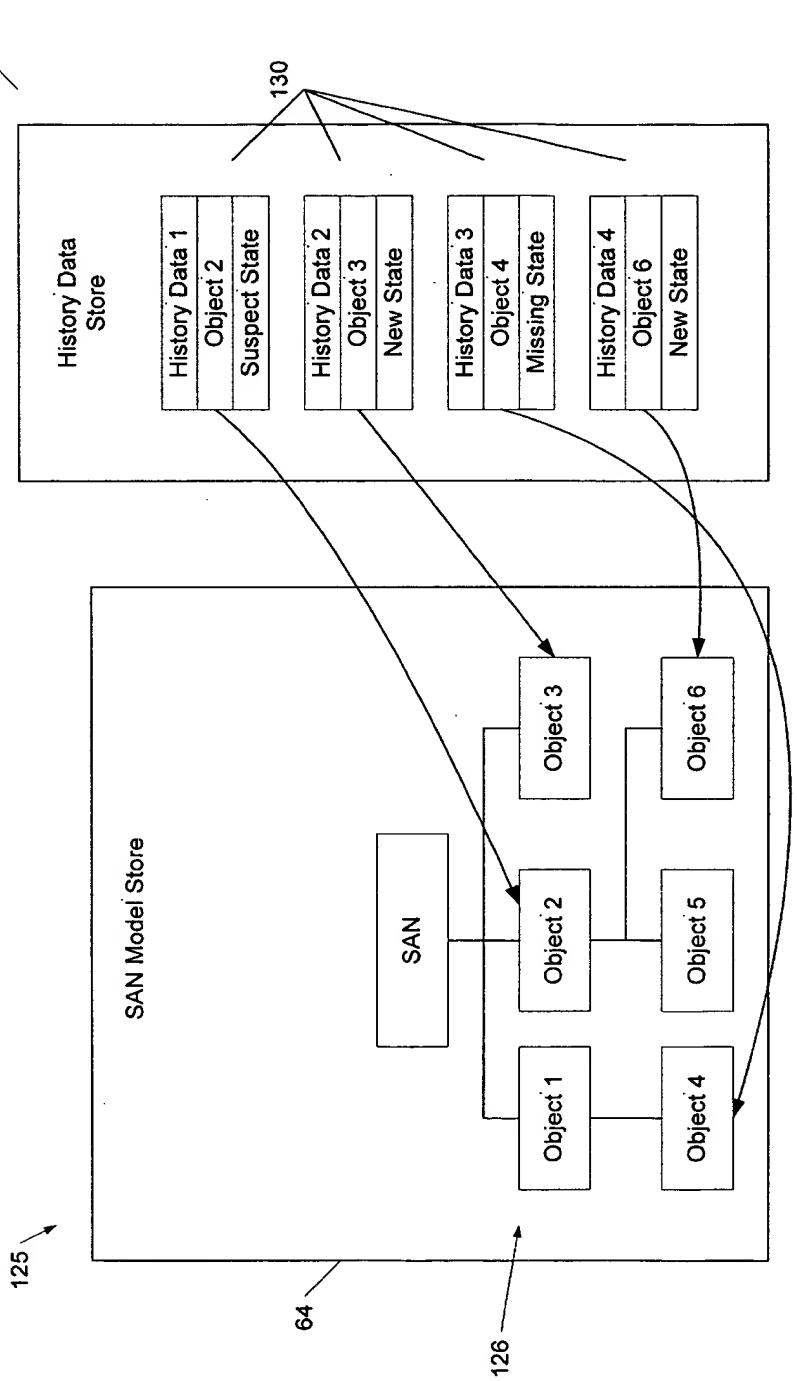

128
130
History Data Store
History Data 1
Object 2
Suspect State
History Data 2
Object 3
New State
History Data 3
Object 4
Missing State
History Data 4
Object 6
New State
SAN Model Store
SAN
Object 1
Object 2
Object 3
Object 4
Object 5
Object 6
125
64
126

FIGURE 25

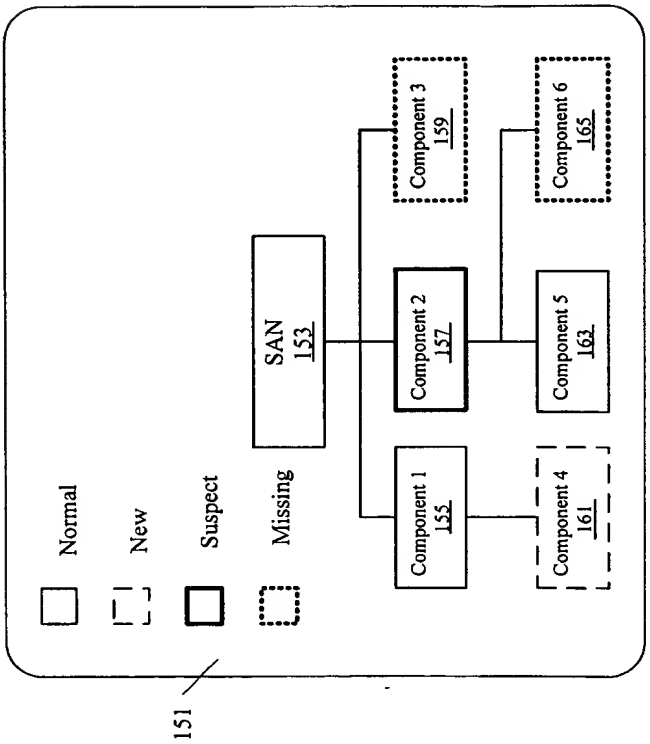

Normal
New
Suspect
Missing
SAN
153
Component 1
155
Component 2
157
Component 3
159
Component 4
161
Component 5
163
Component 6
165
151

FIGURE 26

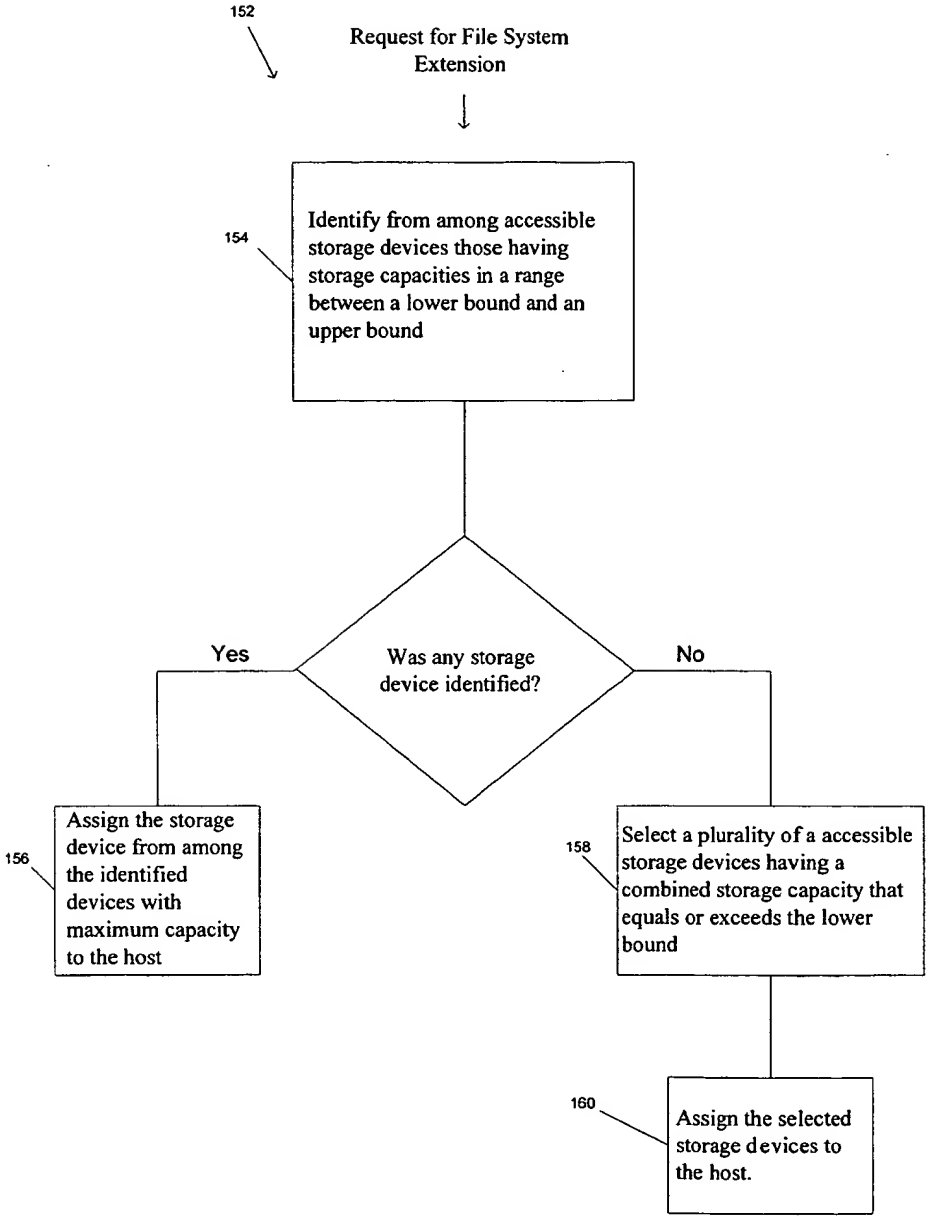

152
Request for File System Extension
154
Identify from among accessible storage devices those having storage capacities in a range between a lower bound and an upper bound
Was any storage device identified?
Yes
No
156
Assign the storage device from among the identified devices with maximum capacity to the host
158
Select a plurality of a accessible storage devices having a combined storage capacity that equals or exceeds the lower bound
160
Assign the selected storage devices to the host.

Figure 27

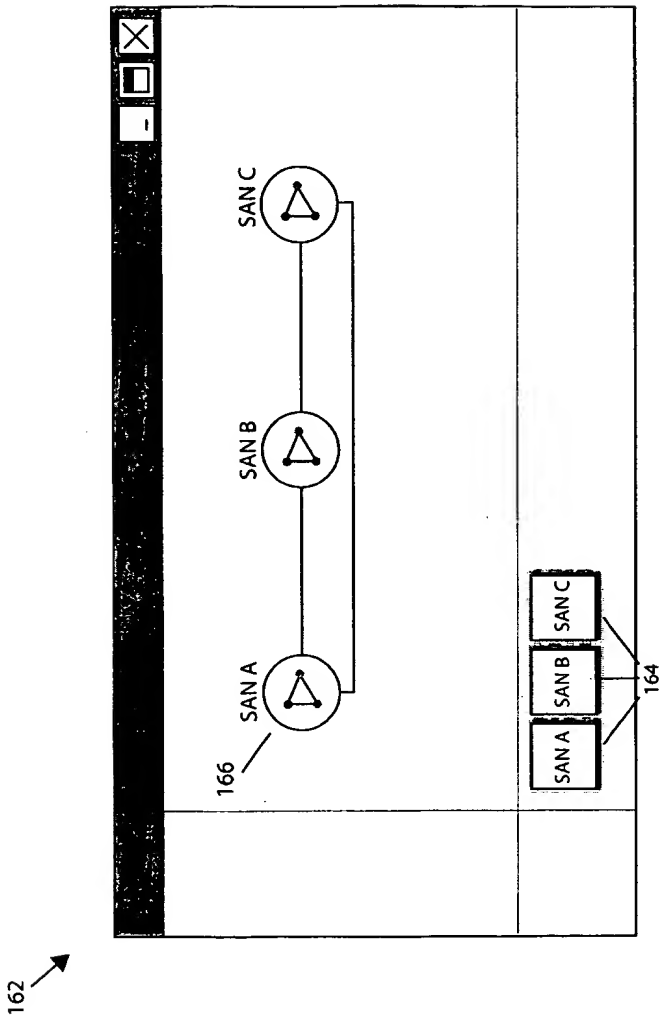


Figure 28

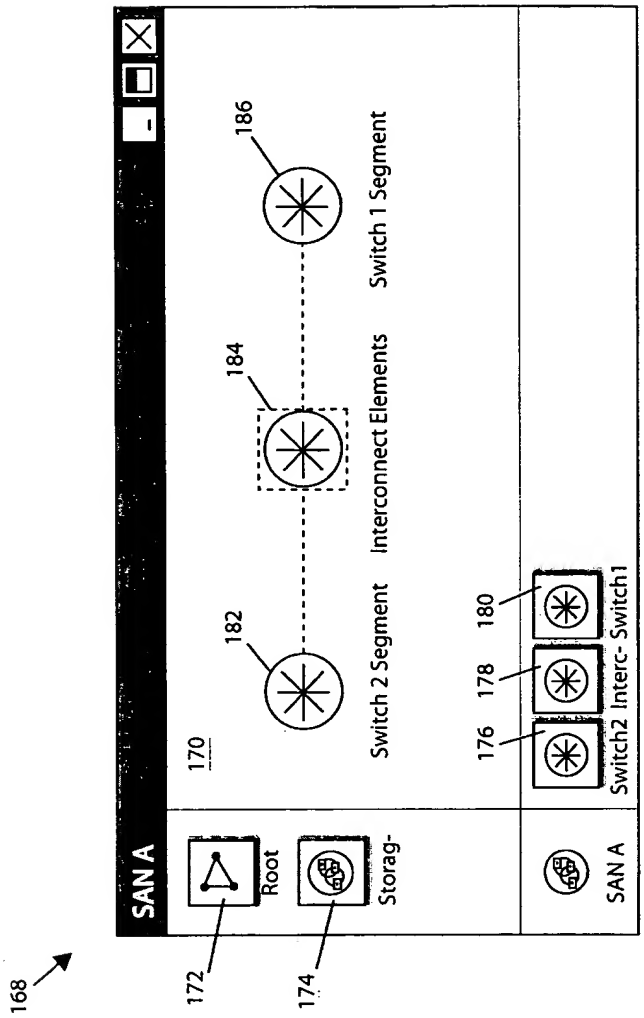

SAN A
170
Root
Storag-
172
174
168
182
184
186
Switch 2 Segment
Interconnect Elements
Switch 1 Segment
176
178
180
Switch2 Interc- Switch1
SAN A

Figure 29

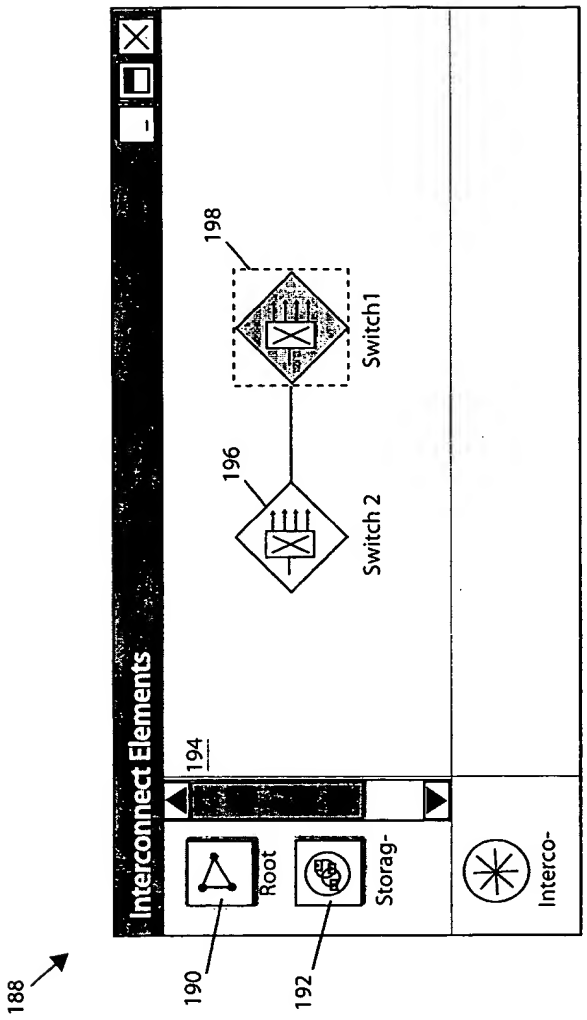

188
190
192
194
196
198
Interconnect Elements
Root
Storag-
Interco-
Switch 2
Switch1

Figure 30

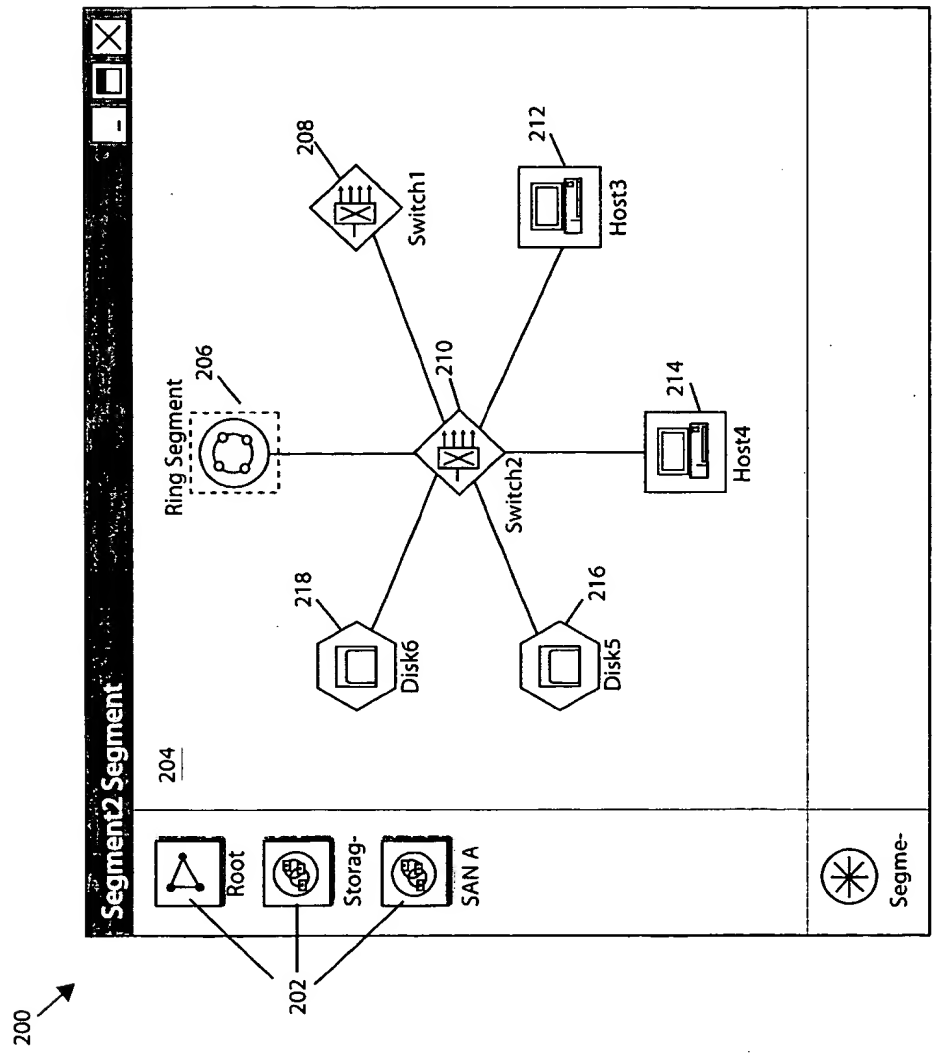

200
202
Root
Storag-
SAN A
Segme-
Segment2 Segment
204
Ring Segment
206
208
Switch1
210
Switch2
212
Host3
214
Host4
216
Disk5
218
Disk6

Figure 31

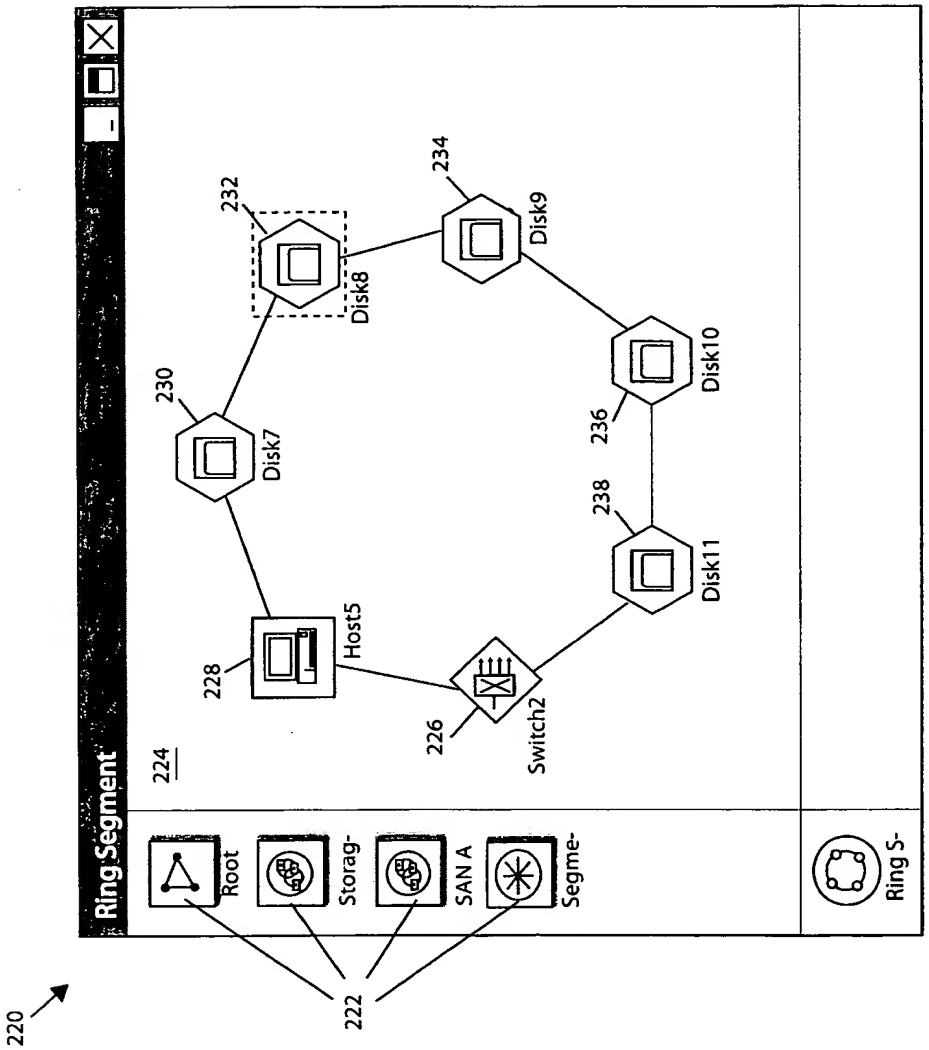
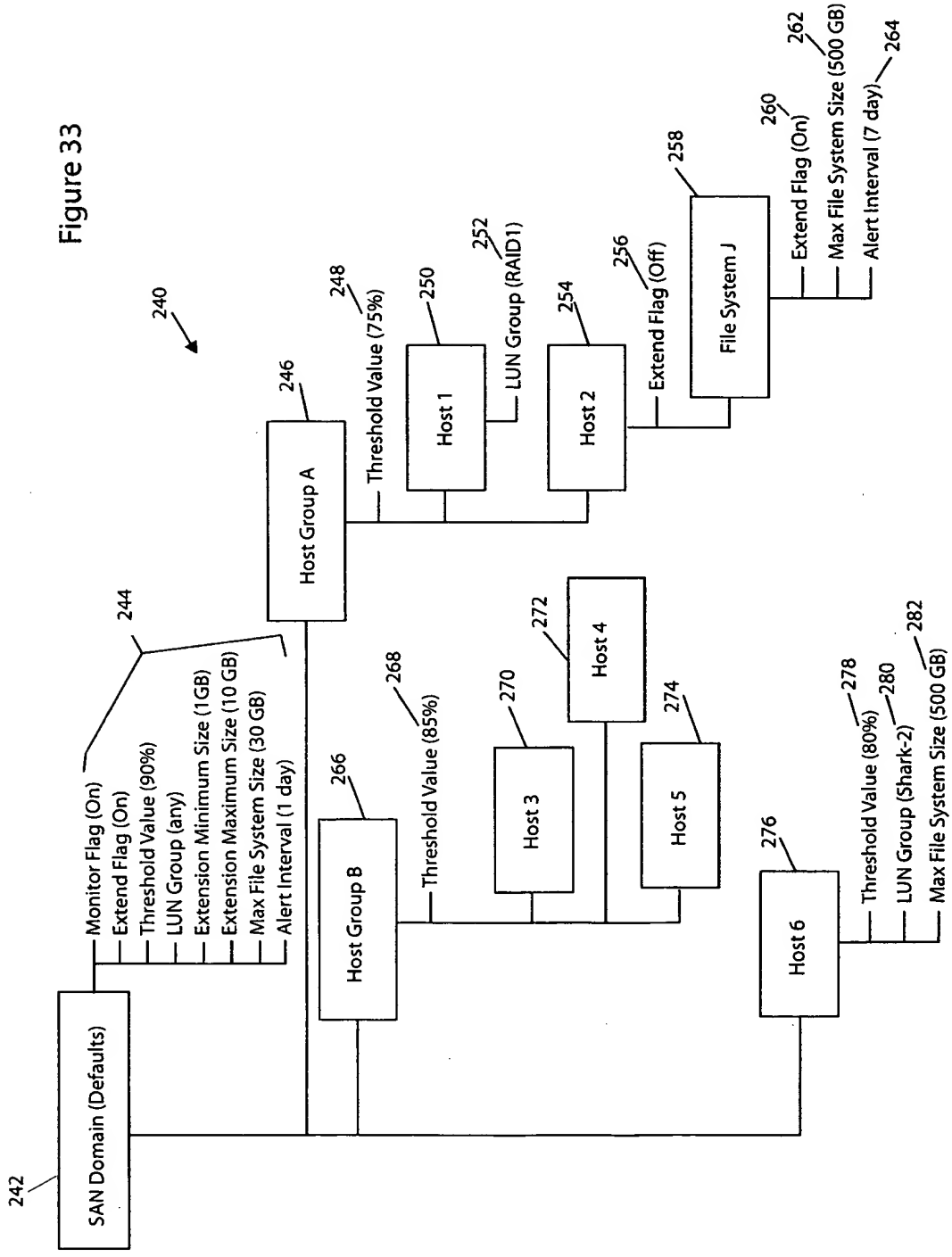

220
222
Ring Segment
224
Root
Storag-
SAN A
Segme-
Ring S-
Host5
228
Switch2
226
Disk7
230
Disk8
232
Disk9
234
Disk10
236
Disk11
238

Figure 32

Figure 33


240
242
SAN Domain (Defaults)
244
Monitor Flag (On)
Extend Flag (On)
Threshold Value (90%)
LUN Group (any)
Extension Minimum Size (1GB)
Extension Maximum Size (10 GB)
Max File System Size (30 GB)
Alert Interval (1 day)
246
Host Group A
248
Threshold Value (75%)
250
Host 1
252
LUN Group (RAID1)
254
Host 2
256
Extend Flag (Off)
258
File System J
260
Extend Flag (On)
262
Max File System Size (500 GB)
264
Alert Interval (7 day)
266
Host Group B
268
Threshold Value (85%)
270
Host 3
272
Host 4
274
Host 5
276
Host 6
278
Threshold Value (80%)
280
LUN Group (Shark-2)
282
Max File System Size (500 GB)

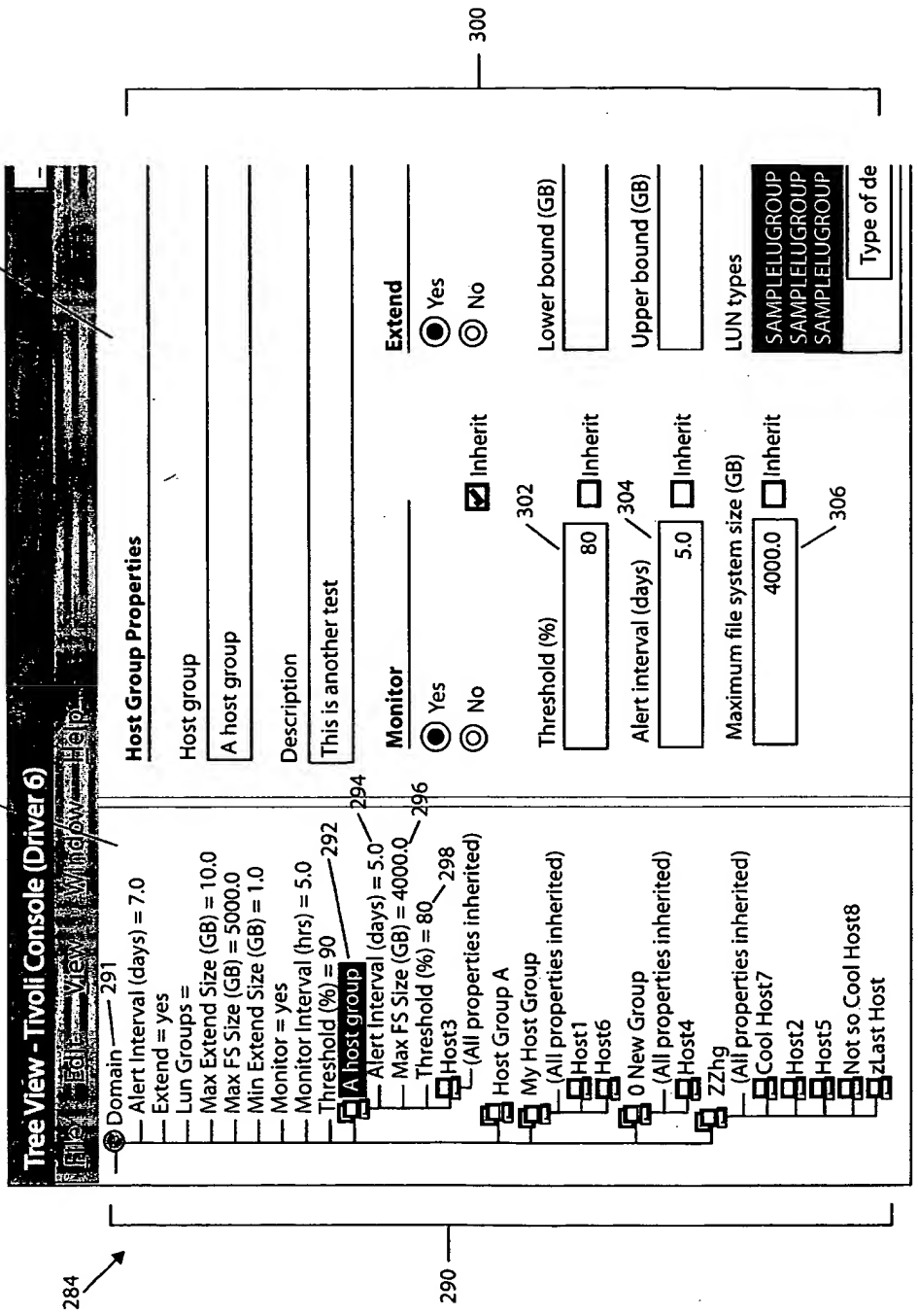

Tree View - Tivoli Console (Driver 6)
File Edit View Window Help
Domain
Alert Interval (days) = 7.0
Extend = yes
Lun Groups =
Max Extend Size (GB) = 10.0
Max FS Size (GB) = 5000.0
Min Extend Size (GB) = 1.0
Monitor = yes
Monitor Interval (hrs) = 5.0
Threshold (%) = 90
A host group
Alert Interval (days) = 5.0
Max FS Size (GB) = 4000.0
Threshold (%) = 80
Host3
(All properties inherited)
Host Group A
My Host Group
(All properties inherited)
Host1
Host6
0 New Group
(All properties inherited)
Host4
ZZhg
(All properties inherited)
Cool Host7
Host2
Host5
Not so Cool Host8
zLast Host
Host Group Properties
Host group
A host group
Description
This is another test
Monitor
Yes
No
Inherit
Extend
Yes
No
Threshold (%)
80
Inherit
Lower bound (GB)
Alert interval (days)
5.0
Inherit
Upper bound (GB)
Maximum file system size (GB)
4000.0
Inherit
LUN types
SAMPLELUGROUP
SAMPLELUGROUP
SAMPLELUGROUP
Type of de
284
286
288
290
291
292
294
296
298
300
302
304
306

Figure 34

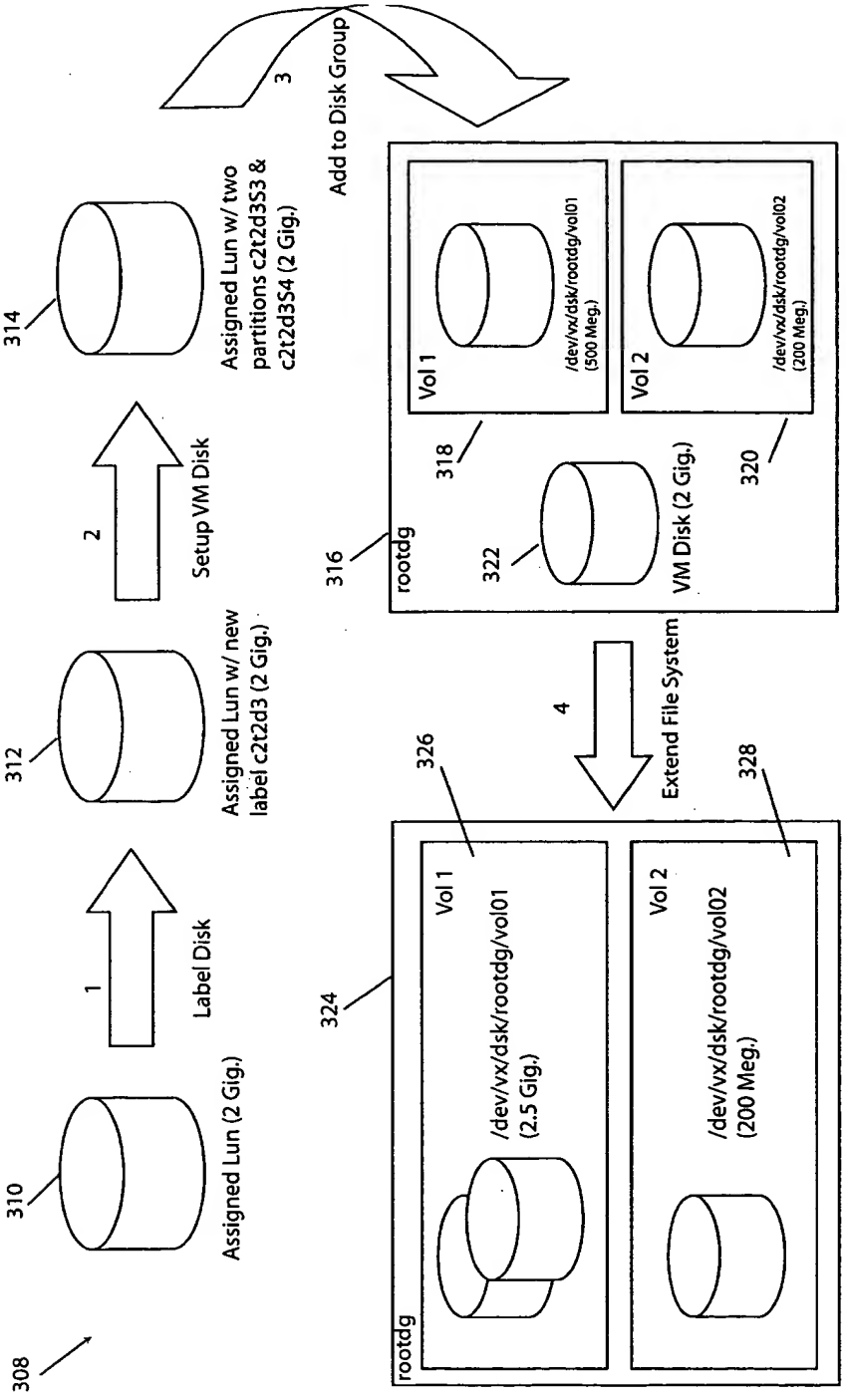

308
310
Assigned Lun (2 Gig.)
1
Label Disk
312
Assigned Lun w/ new label c2t2d3 (2 Gig.)
2
Setup VM Disk
314
Assigned Lun w/ two partitions c2t2d3S3 & c2t2d3S4 (2 Gig.)
3
Add to Disk Group
316
rootdg
318
Vol 1
/dev/vx/dsk/rootdg/vol01 (500 Meg.)
320
Vol 2
/dev/vx/dsk/rootdg/vol02 (200 Meg.)
322
VM Disk (2 Gig.)
4
Extend File System
324
rootdg
326
Vol 1
/dev/vx/dsk/rootdg/vol01 (2.5 Gig.)
328
Vol 2
/dev/vx/dsk/rootdg/vol02 (200 Meg.)

Figure 35

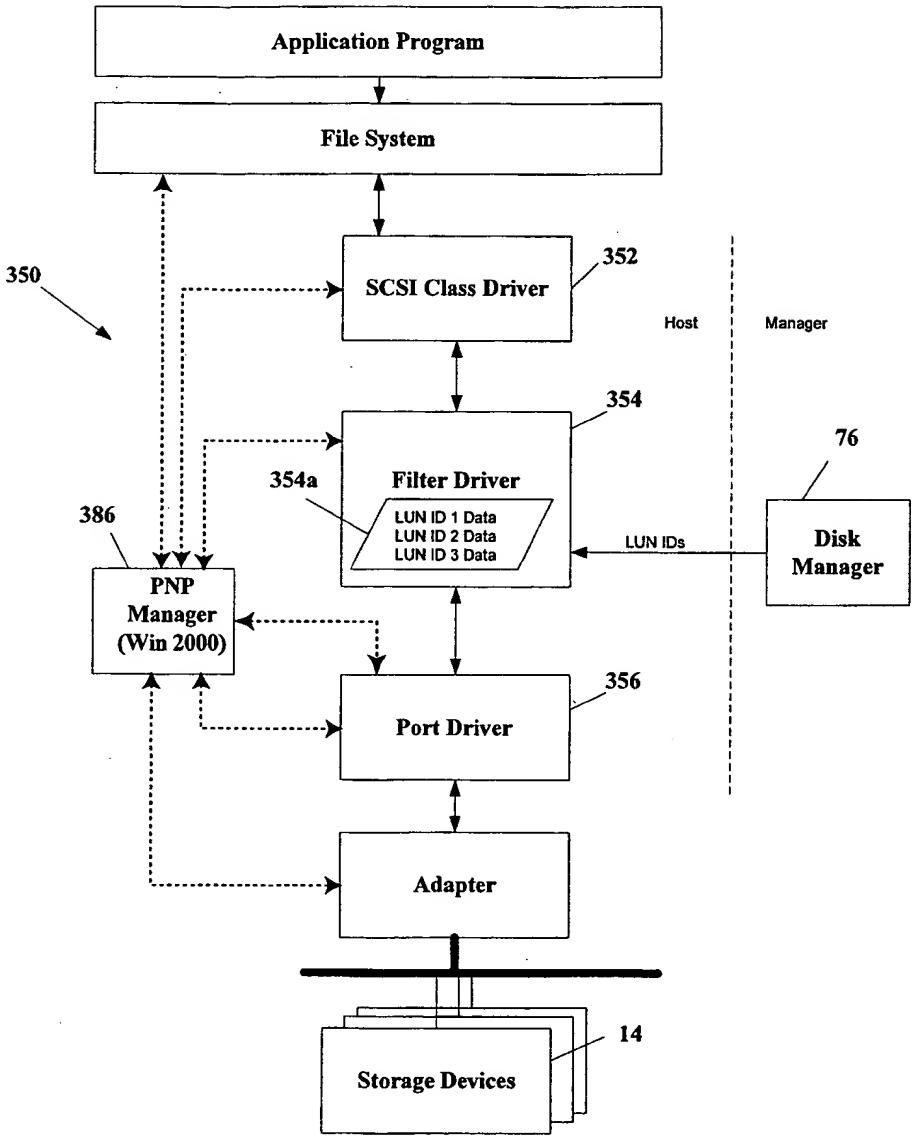
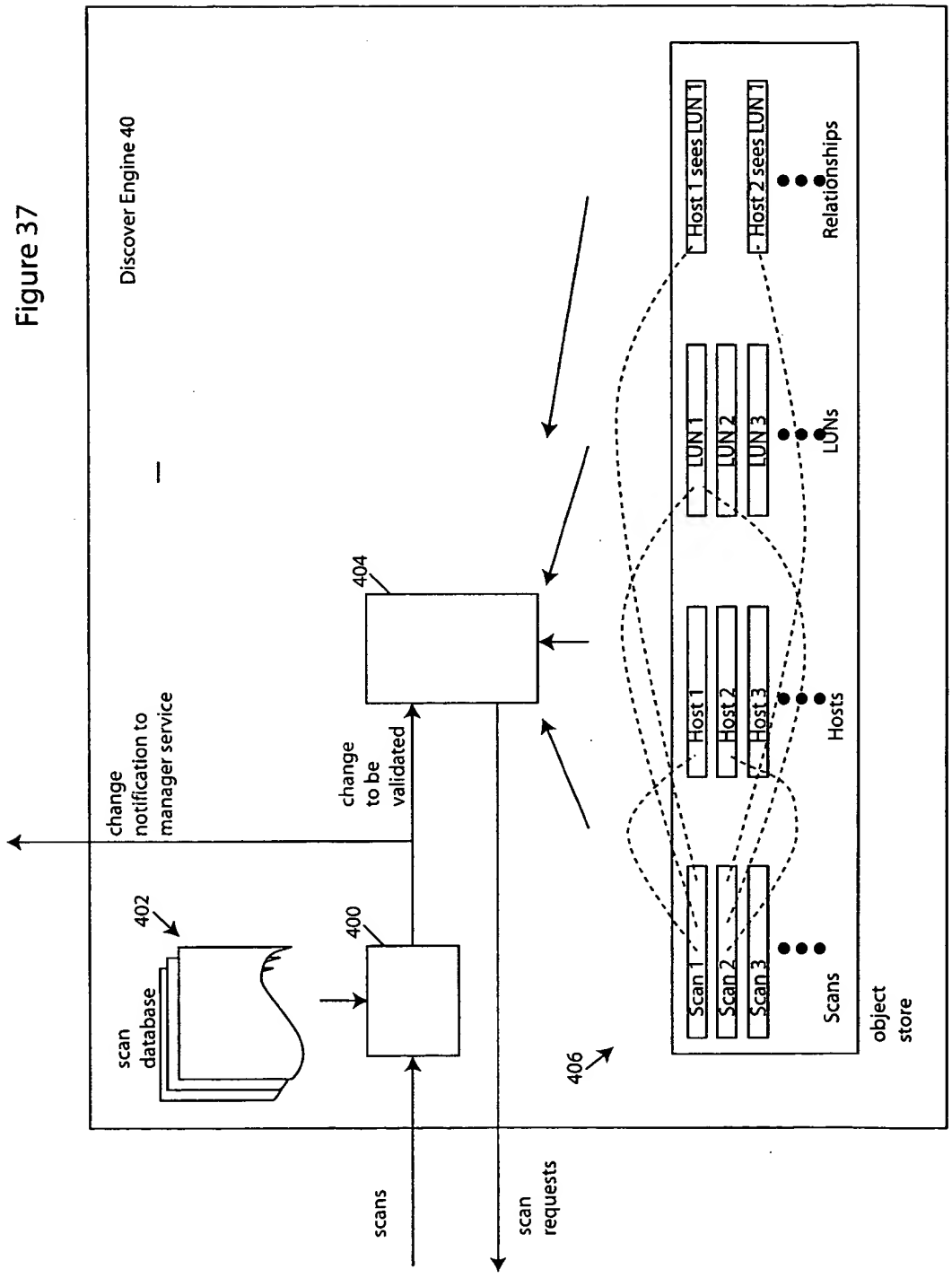

Application Program
File System
SCSI Class Driver
352
350
Host
Manager
354
Filter Driver
354a
LUN ID 1 Data
LUN ID 2 Data
LUN ID 3 Data
76
386
LUN IDs
Disk Manager
PNP Manager (Win 2000)
356
Port Driver
Adapter
14
Storage Devices

FIGURE 36

Figure 37


Discover Engine 40
change notification to manager service
change to be validated
404
402
400
scan database
406
scans
scan requests
Host 1 sees LUN 1
Host 2 sees LUN 1
Relationships
LUN 1
LUN 2
LUN 3
LUNs
Host 1
Host 2
Host 3
Hosts
Scan 1
Scan 2
Scan 3
Scans
object store

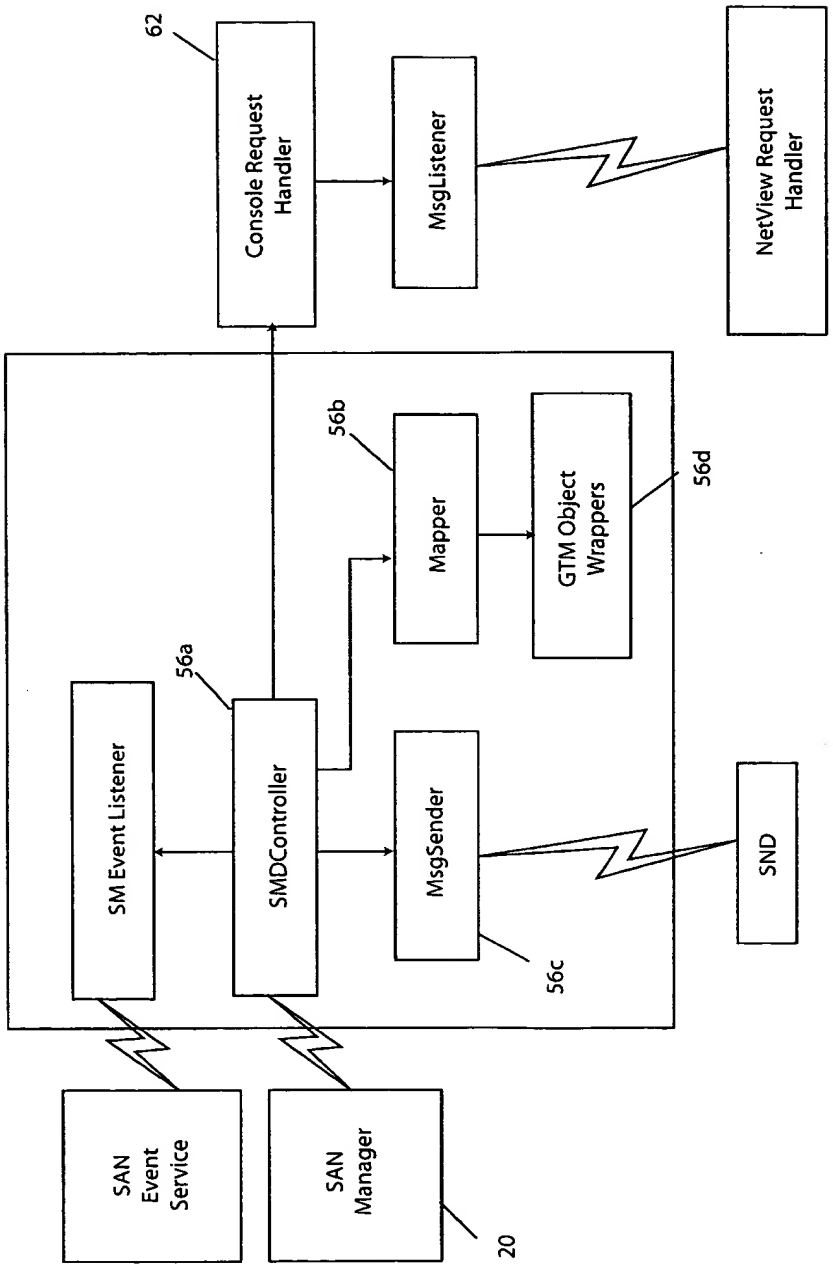

62
Console Request Handler
MsgListener
NetView Request Handler
56b
Mapper
GTM Object Wrappers
56d
56a
SM Event Listener
SMDController
MsgSender
SND
56c
SAN Event Service
SAN Manager
20

Figure 38

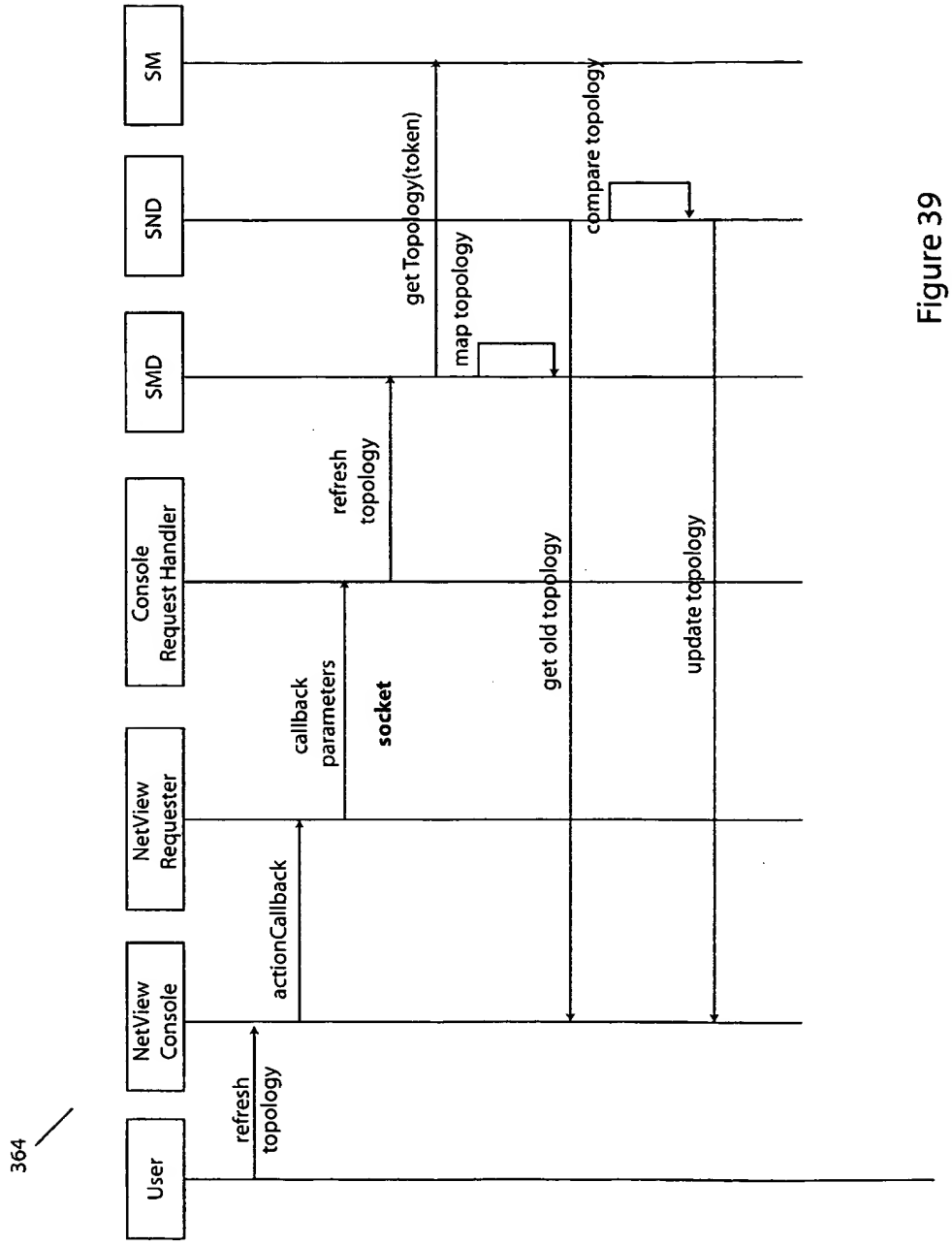

364
User
NetView Console
NetView Requester
Console Request Handler
SMD
SND
SM
refresh topology
actionCallback
callback parameters
socket
refresh topology
get Topology(token)
map topology
get old topology
compare topology
update topology

Figure 39

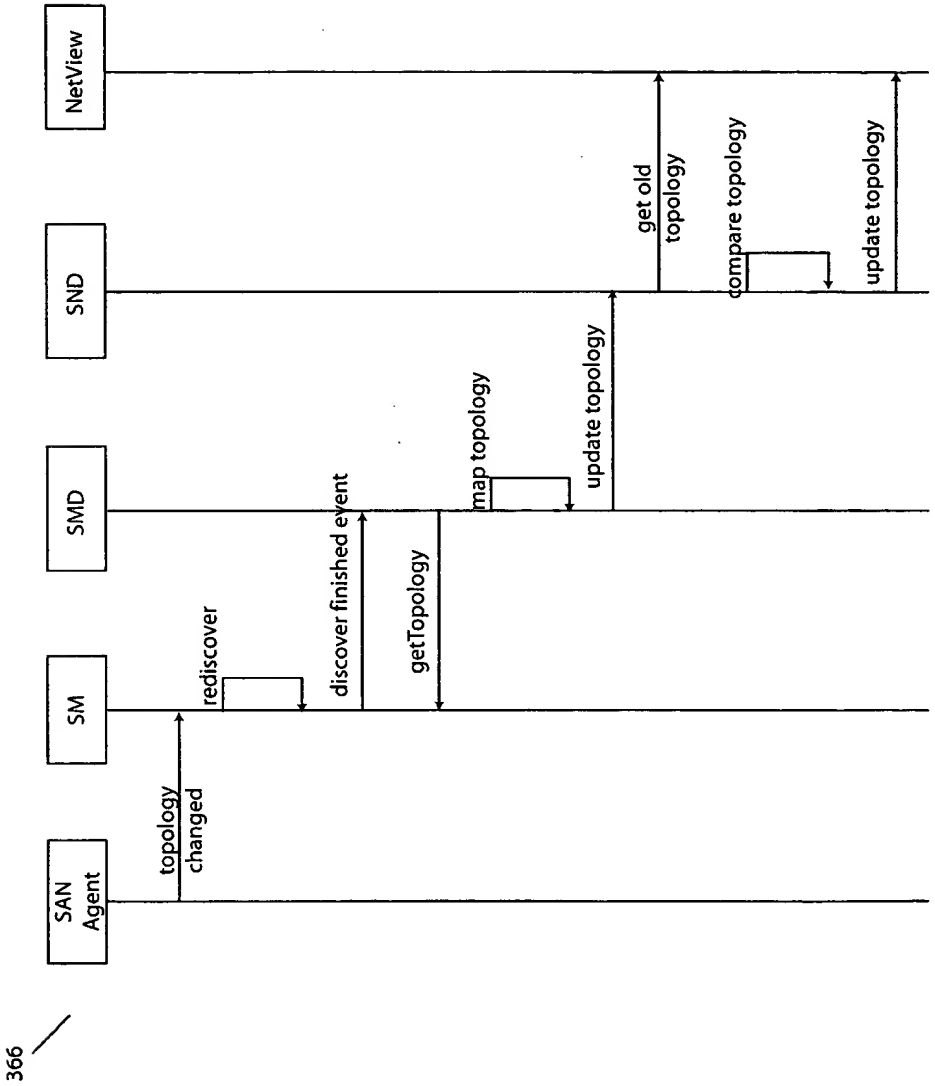

NetView
SND
SMD
SM
SAN Agent
topology changed
rediscover
discover finished event
getTopology
map topology
update topology
get old topology
compare topology
update topology
366

Figure 40

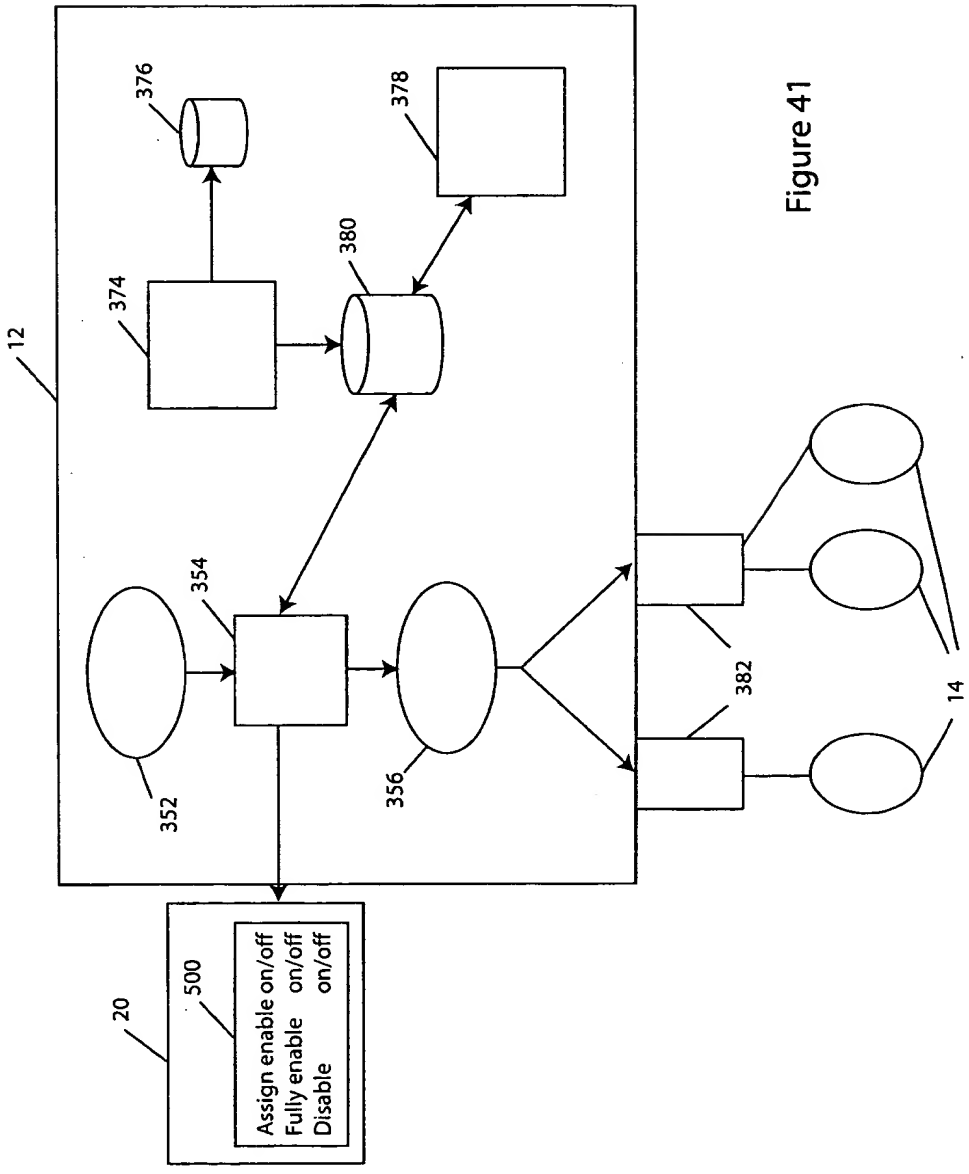

12
376
378
380
374
354
352
356
382
14
20
500
Assign enable on/off
Fully enable on/off
Disable on/off

Figure 41

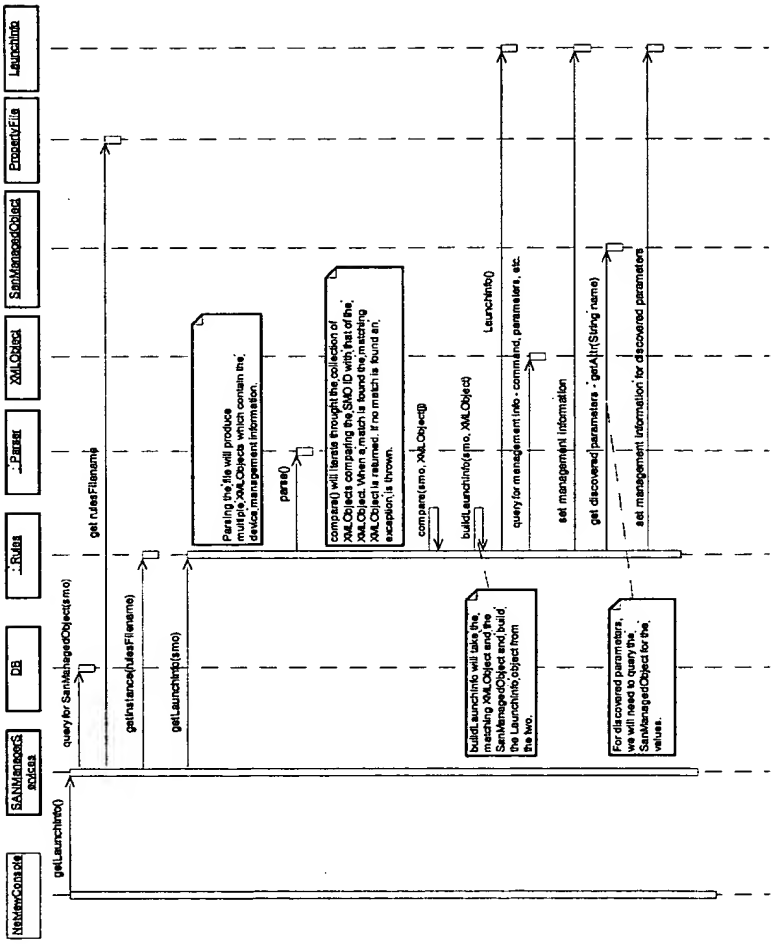

NtsWebConsole
SANManagedObjects
DB
:Rules
:Parser
XMLObject
SanManagedObject
PropertyFile
LaunchInfo
getLaunchInfo()
query for SanManagedObjects(smo)
getInstance(rulesFilename)
getLaunchInfo(smo)
get rulesFilename
Parsing the file will produce multiple XMLObjects which contain the device management information.
parse()
compare() will iterate trought the collection of XMLObjects comparing the SMO ID with that of the XMLObject. When a match is found the matching XMLObject is returned. If no match is found an exception is thrown.
compare(smo, XMLObject)
buildLaunchInfo(smo, XMLObject)
LaunchInfo()
query for management info - command, parameters, etc.
set management information
get discovered parameters - getAttr(String name)
set management information for discovered parameters
buildLaunchInfo will take the matching XMLObject and the SanManagedObject and build the LaunchInfo object from the two.
For discovered parameters, we will need to query the SanManagedObject for the values.

Figure 42

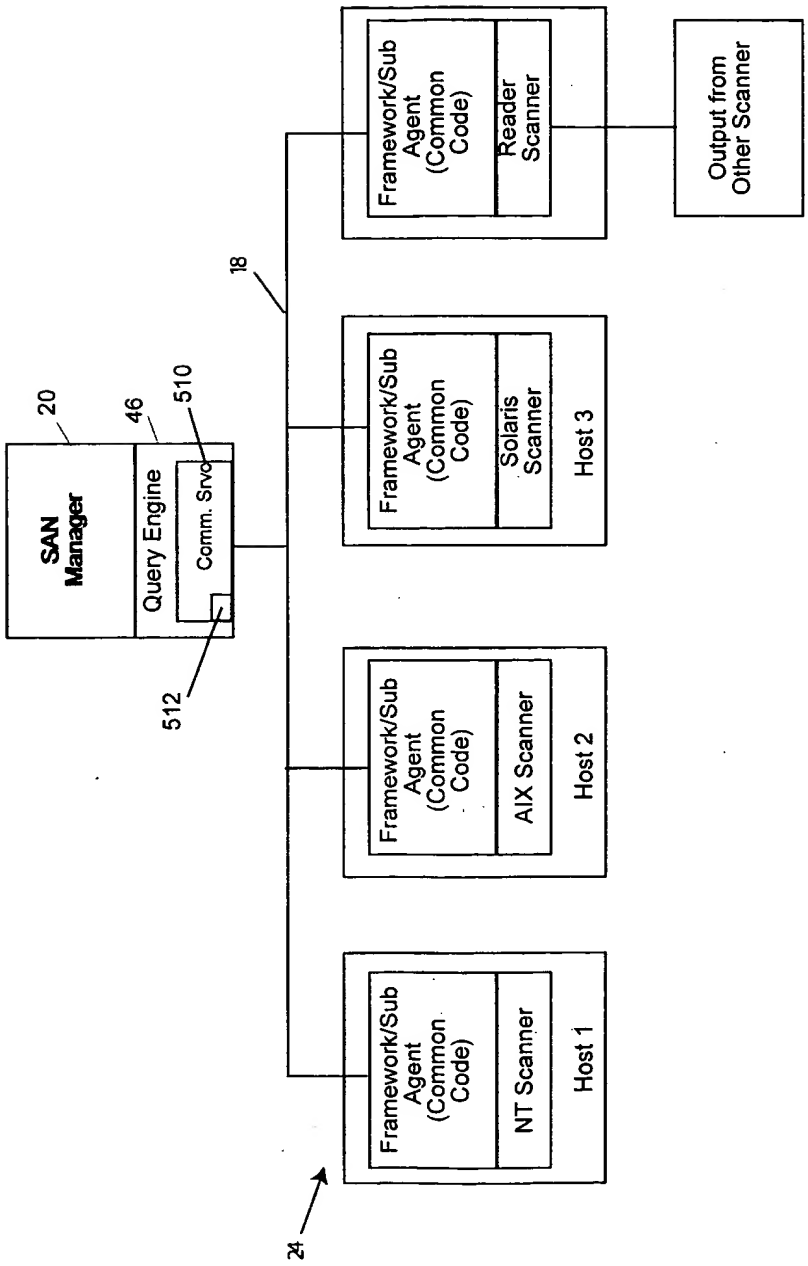

SAN Manager
Query Engine
Comm. Srvc
20
46
510
512
18
24
Framework/Sub Agent (Common Code)
NT Scanner
Host 1
Framework/Sub Agent (Common Code)
AIX Scanner
Host 2
Framework/Sub Agent (Common Code)
Solaris Scanner
Host 3
Framework/Sub Agent (Common Code)
Reader Scanner
Output from Other Scanner

Figure 43